FINAL SITE INSPECTION OF PER- AND POLYFLUOROALKYL SUBSTANCES

Picatinny Arsenal, New Jersey

Prepared For:
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Site Inspection of Per- and Polyfluoroalkyl Substances

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ACRONYMS

°F	degrees Fahrenheit
%	percent
6:2 FTSA	6:2 fluorotelomer sulfonate
8:2 FTSA	8:2 fluorotelomer sulfonate
AFFF	aqueous film-forming foam
AOPI	area of potential interest
Arcadis	Arcadis U.S., Inc.
Army	U.S. Army
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CSM	conceptual site model
DoD	Department of Defense
DQO	data quality objectives
DUSR	Data Usability Summary Report
EB	equipment blank
EDR	Environmental Data Resources, Inc.
ELAP	Environmental Laboratory Accreditation Program
FB	field blank
GAC	granular activated carbon
GPB	Green Pond Brook
HQ	hazard quotient
IDW	investigation-derived waste
ILCR	incremental lifetime cancer risk
IAG	Interagency Agreement with EPA and Army
installation	U.S. Army and Reserve installation
IRP	Installation Restoration Program
LHA	lifetime health advisory (USEPA)
LOD	limit of detection
LOQ	limit of quantitation

LTM	long-term monitoring
LUC	land use control
mg/kg	milligrams per kilogram (parts per million)
NA	not available
ng/L	nanogram per liter (parts per trillion)
NJ	New Jersey
NJARNG	New Jersey Army National Guard
NJDEP	New Jersey Department of Environmental Protection
OSD	Office of the Secretary of Defense
PA	preliminary assessment
PFAS	per- and polyfluoroalkyl substances
PFBA	perfluorobutanoic acid
PFBS	perfluorobutanesulfonic acid
PFDA	perfluorodecanoic acid
PFDoA	perfluorododecanoic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PFPA	perfluoropentanoic acid
PFTA	perfluorotetradecanoic acid
PFTrDA	perfluorotridecanoic acid
PFUnA	perfluoroundecanoic acid
PICA	Picatinny Arsenal
PQAPP	Programmatic Uniform Federal Policy-Quality Assurance Project Plan
PSL	project screening level
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control

QSM	Quality Systems Manual
RSL	regional screening level
RSSL	residential scenario screening level
SI	site inspection
SOP	standard operating procedure
SSHP	Site Safety and Health Plan
TGI	technical guidance instruction
U.S.	United States
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USEPA	United States Environmental Protection Agency
WWTP	wastewater treatment plant

EXECUTIVE SUMMARY

The United States (U.S.) Army (Army) is performing site inspections (SIs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS), with a focus on perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS) at U.S. Army installations (installations) nationwide. The objective of an SI is to identify whether there has been a release to the environment from any of the AOPIs identified in the PA. Where necessary, the SI includes multi-media sampling at AOPIs to determine whether or not a release has occurred, and the PFOS, PFOA, and PFBS results in groundwater, surface water, soil, and/or sediment are compared to the 2019 Office of the Secretary of Defense (OSD) risk screening levels. This report provides the SI for Picatinny Arsenal (PICA) and was completed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and The National Oil and Hazardous Substance Pollution Contingency Plan (NCP).

PICA, which covers approximately 5,801 acres, contains both improved and unimproved lands and is located in Rockaway Township, Morris County, New Jersey (NJ) approximately 45 miles west of New York City and four miles northeast of Dover, NJ. During the PA, ten AOPIs were identified. Each of these AOPIs was investigated during the SI. In addition, because PFOS was detected in groundwater samples collected from monitoring wells at the southern boundary of PICA (detected at a maximum concentration of 300 nanograms per liter [ng/L]), groundwater samples were also collected from private off-post potable wells.

PFAS were detected at concentrations greater than the OSD risk screening levels at nine of the ten AOPIs. The percentage of samples from each AOPI and each media that had detections, as well as concentrations above the OSD risk screening levels, are given in **Table ES-1**.

Table ES-1. Percentage of Analytical Data PFAS Detected and Above OSD Risk Screening Levels

Location	Groundwater		Surface Water		Soil	
	No. Samples / % Detected	No. samples / % > OSD Screening Levels	No. Samples / % Detected	No. samples / % > OSD Screening Levels	No. Samples / % Detected	No. samples / % > OSD Screening Levels
Building 169 – Firehouse 1	1 / 100%	1 / 100%	0 / NA	0 / NA	0 / NA	0 / NA
Buildings 3316/3321 – Firehouse 2	2 / 100%	2 / 100%	0 / NA	0 / NA	2 / 100%	2 / 100%
Former Pyrotechnic Area and Sanitary Landfill	3 / 100%	3 / 33%	0 / NA	0 / NA	0 / NA	0 / NA
Former Lower Burning Grounds	5 / 60%	5 / 0%	2 / 100%	2 / 100%	0 / NA	0 / NA
Area 1222 - Gorge	3 / 100%	3 / 33%	2 / 50%	2 / 0%	1 / 100%	1 / 0%
Lawn to the North of Building 3409/3410	2 / 100%	2 / 50%	1 / 100%	1 / 100%	2 / 50%	2 / 0%
Former Building 24	2 / 100%	2 / 50%	0 / NA	0 / NA	0 / NA	0 / NA

Location	Groundwater		Surface Water		Soil	
	No. Samples / % Detected	No. samples / % > OSD Screening Levels	No. Samples / % Detected	No. samples / % > OSD Screening Levels	No. Samples / % Detected	No. samples / % > OSD Screening Levels
Post Farm Landfill	3 / 100%	3 / 0%	0 / NA	0 / NA	0 / NA	0 / NA
Former WWTP Facility	5 / 80%	5 / 0%	2 / 100%	2 / 50%	1 / 100%	1 / 0%
Building 3801 – New Jersey Army National Guard Helipad Area	2 / 100%	2 / 0%	1 / 100%	1 / 100%	2 / 50%	2 / 0%
Totals	28 / 89%	28 / 25%	8 / 87%	8 / 62%	8 / 75%	8 / 25%

Notes:
1. No. of Samples are the total number of samples collected from that media in that AOPI
2. The percentages are based on PFAS detections and includes PFOS, PFOA, and/or PFBS results.
3. The OSD screening levels are the following:
    a. Tap Water and Surface Water (parts per trillion) – PFOS – 40; PFOA – 40; PFBS – 600
    b. Residential Soil (parts per million) – PFOS – 0.13; PFOA – 0.13; PFBS – 130
4. NA – not applicable

Results from this SI indicate further investigation for PFAS, through a remedial investigation (RI), is warranted at PICA in accordance with the October 2019 guidance provided by the OSD. All recommendations are based on data collected by the Army during the SI. **Table ES-2** below summarizes the sampling at PICA and the rationale for recommendations for future investigations or no action at this time.

Table ES-2. Summary of PFAS Sampling at PICA and Recommendations

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels?				Recommendation	Rationale
	GW	SO	SW	SE		
Building 169 – Firehouse 1	Yes	NS	NS	NS	Future investigation through an RI	GW exceedance of OSD risk screening levels
Buildings 3316/3321 – Firehouse 2	Yes	Yes	NS	NS	Future investigation through an RI	GW and SO exceedance of OSD risk screening levels
Former Pyrotechnic Area and Sanitary Landfill	Yes	NS	NS	NS	Future investigation through an RI	GW exceedance of OSD risk screening levels
Former Lower Burning Grounds	No	NS	Yes	NS	Future investigation through an RI	SW exceedance of OSD risk screening levels
Area 1222 – Gorge	Yes	No	No	NS	Future investigation through an RI	GW exceedance of OSD risk screening levels

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels?				Recommendation	Rationale
	GW	SO	SW	SE		
Lawn to the North of Building 3409/3410	Yes	No	Yes	NS	Future investigation through an RI	GW and SW exceedance of OSD risk screening levels
Former Building 24	Yes	NS	NS	NS	Future investigation through an RI	GW exceedance of OSD risk screening levels
Post Farm Landfill	No	NS	NS	NS	No action	No exceedances of OSD risk screening levels in GW
Former WWTP Facility	No	No	Yes	NS	Future investigation through an RI	SW exceedance of OSD risk screening levels
Building 3801 – New Jersey Army National Guard Helipad Area	No	No	Yes	NS	Future investigation through an RI	SW exceedance of OSD risk screening levels

Notes:
GW – groundwater
NS – not sampled
SE – sediment
SO – soil
SW – surface water

1 INTRODUCTION

The U.S. Army (Army) is performing preliminary assessments (PAs) and site inspections (SIs) on the current or potential historical use of per-and polyfluoroalkyl substance (PFAS) with a focus on perfluorooctanoic acid (PFOS), and perfluorobutanesulfonic acid (PFBS), at Army installations (installations) nationwide. The Army is the lead agency under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Executive Order 12,580 and is conducting the PA/SI consistent with its authority under CERCLA, 42 United States Code §§ 9600, et seq. (as amended), the Interagency Agreement with the United States Environmental Protection Agency (the IAG), and the Defense Environmental Restoration Program, 10 United States Code §§ 2701, et seq. The PFAS PA/SI included two distinct efforts. The PA identified locations that are areas of potential interest (AOPIs) at PICA based on the use, storage, or disposal of AFFF and/or potential PFAS containing materials, in accordance with the 2018 Army Guidance for Addressing Releases of Per-and Polyfluoroalkyl Substance (Army 2018). Where necessary, the SI included multi-media sampling at AOPIs to determine whether or not a release has occurred, and the PFOS, PFOA and PFBS results in groundwater, surface water, soil, and or sediment were compared to the 2019 Office of Secretary of Defense (OSD) PFAS risk screening levels. This report provides the SI for PICA and was completed in accordance with CERCLA and The National Oil and Hazardous Substance Pollution Contingency Plan (NCP).

1.1 Project Background

PFAS are a class of compounds that have been used in a wide range of industrial applications and commercial products due to their unique surface tension/leveling properties. Due to industry and regulatory concerns about the potential health effects and adverse environmental impacts, there has been a reduction in the manufacture and use of PFAS worldwide. In the U.S., significant reductions in the production, importation, and use of PFOS and PFOA (two individual compounds in the PFAS class) occurred between 2001 and 2015 (Interstate Technology Regulatory Council 2017). PFBS replaced PFOS in some applications and is currently used and manufactured in the U.S.

The focus of the PA is to identify the locations at installations, which may be later categorized as areas of potential interest (AOPIs), where AFFF and/or PFAS-containing materials were used, stored, and/or disposed. AFFF was developed in the late-1960s in response to a need for firefighting foams better suited to extinguish Class B, fuel-based fires. AFFF formulations consist of water, an organic solvent, up to 5 percent (%) hydrocarbon surfactants, and 1 to 3% PFAS (Interstate Technology Regulatory Council 2020). AFFF concentrate is designed to be diluted with water to become a 1, 3, or 6% foam. AFFF releases at Department of Defense (DoD) facilities may have occurred during firefighter training, emergency response actions, equipment testing, or accidental releases. The military still primarily uses AFFF for Class B fires; however, the current formulation of AFFF contains significantly lower amounts of regulated PFAS (such as PFOA and PFOS), and significant operational changes have been implemented to restrict uncontrolled releases and non-essential use of PFAS-based foams. Army installations may still house AFFF, commonly stored in closed containers (e.g., 55-gallon drums, 5-gallon buckets), within designated storage buildings or at firehouses.

Potential PFAS use associated with chromium plating activities (generally prior to the late-1990s) may also be relevant to Army installations. During hard chromium plating, a metal surface is treated with a layer of electrochemically deposited chromium in a chromic acid bath. PFAS, specifically PFOS, have been used in hard chromium plating operations as surface tension-reducing wetting agents to mitigate the release of aerosolized hexavalent chromium into a working environment. Historically, it was common for spent plating baths from plating operations to be disposed of in a lined or unlined pit or into a sanitary or storm sewer. Therefore, PFAS present in mist suppressants during the plating process could be released to the environment.

Many of the PFAS found in AFFF and chromium plating operations are surfactants (which do not volatilize) and are found in a charged or ionic state at environmental pH (i.e., pH 5 to 9 standard units), including PFOS, PFOA, and PFBS, which are negatively charged. The media potentially affected by PFAS releases at Army installations are soil, groundwater, surface water, and sediment. Once within the environment, the main factor that inhibits the movement of PFAS is the presence of organic matter and organic co-constituents in soils and sediments. Generally, PFAS are mobile in the potentially affected media, and they are not known to be broken down by natural processes.

In 2016, the United States Environmental Protection Agency (USEPA) established a lifetime health advisory (LHA) of 70 ng/L in drinking water for PFOS or PFOA and for the sum of PFOS and PFOA when both are present (USEPA 2016). In November 2018, the USEPA also issued draft subchronic and chronic oral toxicity values for PFBS for public comment. The new toxicity values for PFBS are intended to update the current PFBS toxicity values that were finalized in July 2014 (USEPA 2014). USEPA expects to finalize updated toxicity assessments for PFBS in 2021.

On 15 October 2019, OSD provided guidance on the investigation of PFOS, PFOA, and PFBS at DoD locations under the Defense Environmental Restoration Program (OSD 2019). The 15 October 2019 Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program is provided for reference as **Appendix A**. The DoD guidance provides risk screening levels for PFOS, PFOA, and PFBS in groundwater (tap water) or soil, calculated using the USEPA's regional screening level (RSL) calculator for residential and industrial/commercial worker receptor scenarios. The 2019 OSD risk screening levels are discussed further in **Section 4.7**.

1.2 SI Objectives

For PICA, the PA was completed as a standalone document from the SI. The Final PA was approved by the Army in February 2019 (Arcadis 2019c) and provided to both the NJDEP and EPA as reference as it is not considered a Primary Document under the IAG. This SI was conducted after the PA because the results of the PA and Pre-SI sampling results yielded AOPIs that necessitated continuing onto the SI phase in accordance with CERCLA.

The objective of the SI is to identify whether there has been a release to the environment from any of the AOPIs identified in the PA. The SI is typically a limited investigation near suspected releases to evaluate if a release has occurred but is not a comprehensive survey of extent of impacts. This SI was conducted to evaluate presence or absence of PFOS, PFOA and PFBS at the AOPIs identified during the PA process.

Installation-specific data quality objectives (DQOs) and the sampling design and rationale are summarized in **Sections 4.1** and **4.2**.

1.3 SI Process Description

For PICA, SI development followed a similar process as described in **Sections 1.3.1** and **1.3.2** below. Refer to **Appendix B**.

1.3.1 SI Field Work

Following the PA, the SI process was initiated at the installation to evaluate PFAS presence or absence at each AOPI. This process was completed in two phases. During both phases, the work was conducted under a Programmatic Uniform Federal-Policy Quality Assurance Project Plan (PQAPP) (Arcadis 2018c; Arcadis 2019b), as well as installation-specific Quality Assurance Project Plan (QAPP) Addenda (Arcadis 2018b; Arcadis 2019d). The PQAPP details general planning processes for collecting data and describes the implementation of quality assurance (QA) and quality control (QC) activities for the sampling portion of the program for Army installations nationwide. The installation-specific QAPP Addenda define the DQOs, present the sampling design and rationale, and provide qualifications for project personnel. Site Safety and Health Plans (SSHPs) were also developed as attachments to the QAPP Addenda to identify specific health and safety hazards that may be encountered at the installation during sampling (Arcadis 2018b; Arcadis 2019a). The SSHPs were designed to supplement the programmatic Accident Prevention Plan (Arcadis 2018a), which was developed for Army installations nationwide. The QAPP Addenda and SSHPs were submitted to the installation and finalized before commencement of field work, as discussed below. Under the IAG QAPP Addenda also require regulatory approval.

1. Pre-SI Sampling – Due to time constraints to begin field work, the Army and regulators did not review and approve the QAPP Addenda. However, the Army, USEPA, and NJDEP did review and verbally approve the PQAPP. The sampling designs were discussed on conference calls and verbal approval was obtained. The conference call with the Army was held on 28 September 2019 and the conference call with USEPA and NJDEP was held on 30 September 2019.
2. SI Sampling - The QAPP Addenda was submitted to the Army in September 2019 and was approved in October 2019. The QAPP Addenda was submitted by the Army to USEPA and NJDEP in October 2019 and was approved by both in emails dated 1 November 2019.

The DQOs, sampling design and rationale, and field methods employed for the SI at PICA are summarized from the QAPP Addenda developed for PICA (Arcadis, 2018b; Arcadis, 2019d) in **Sections 4.1** through **4.4**.

1. The first phase, referred to as the pre-SI sampling, occurred in 2018 and was initiated prior to the SI due to the detection of PFAS at concentrations above the LHA in the on-post drinking water wells[1]. The purpose of the pre-SI was to determine the presence or absence of PFAS constituents in groundwater at these AOPIs, as well determine the potential for PFAS migration off-post in groundwater and surface water. This sampling was designed to investigate the portion

[1] This sampling was conducted by American Water, the water purveyor for PICA. These data were not used for decision-making purposes in this SI.

of the AOPIs that pose the most direct risk to southern boundary off-post migration. The pre-SI sampling was conducted under the Final PA PQAPP (Arcadis 2018c) and an installation-specific QAPP Addendum (Arcadis 2018b).

2. The second phase was the SI sampling , which was conducted from November 2019 through March 2020. This work was conducted under the Final SI PQAPP, which was finalized in October 2019 (Arcadis 2019b) and the installation-specific QAPP Addendum (Arcadis 2019d) which was approved by USEPA and NJDEP in November 2019.

After finalization of the QAPP Addenda and SSHP, Arcadis teams completed field planning and coordination with the installation and subcontractors. Once the schedule was determined, field teams mobilized to the installation to complete the scope of work defined in the QAPP Addenda.

1.3.2 Data Analysis and Validation

Environmental samples collected during the pre-SI and SI were submitted to a laboratory which is DoD ELAP-accredited for PFAS analysis in accordance with the DoD Quality Systems Manual (QSM) 5.1.1; DoD 2018). Laboratory analytical results were then validated and verified by a project chemist to assess the usability of the data collected. Validated analytical results were summarized in the context of project screening levels (defined in **Section 4.6**) and are included in this SI report.

2 INSTALLATION OVERVIEW

The following subsections provide general information about PICA, including the location and layout, the installation mission(s) over time, a brief site history, current and projected land use, climate, topography, geology, hydrogeology, surface water hydrology, potable wells within a 5-mile radius of the installation, and applicable ecological receptors.

2.1 Site Location

PICA, which covers approximately 5,900 acres, contains both improved and unimproved lands and is located in Rockaway Township, Morris County, New Jersey (NJ) approximately 45 miles west of New York City and four miles northeast of Dover, NJ (**Figure 2-1**). The installation is bordered by numerous major highways including State Route 15, Interstate 80, and U.S. Route 46 (**Figure 2-1**).

2.2 Mission and Brief Site History

PICA was established in the late 1800s as a storage and powder depot. PICA was a major source of munitions for World War I, Work War II, and the Korean and Vietnam Conflicts. During these periods, PICA was involved in the production of explosives, rocket and munitions propellants, pyrotechnic signals and flares, fuzes, and metal components (ECC 2020).

Since 1977, most production of weapons and ammunition has ceased at PICA, and the activities are focused on research and development. PICA is known as the Joint Center of Excellence for Armaments and Munitions, providing products and services to all branches of the U.S. military. PICA houses the headquarters for the Armament Research, Development, and Engineering Center under the U.S. Army Research, Development, and Engineering Command giving it responsibility for developing small caliber weapons and munitions. In 1983, the Army disestablished the Armament Research and Development Command, and PICA became the home of the Armament Research and Development Center. In 1986, the name again changed to the Armament Research, Development, and Engineering Center as further discussed in the PICA Real Property Vision Plan (ECC 2020).

2.3 Current and Projected Land Use

Currently, PICA is an active installation and site of the Army's Armament Research, Development, and Engineering Center whose mission is to conduct or manage research, development, and engineering for all assigned weapon systems for the Army (USAEC 2020).

PICA houses government-operated munitions research and development facilities, operational ranges for munitions testing, residential housing, and recreational facilities that include a golf course and water park. PICA will continue to be used for military research and development, industrial activities, residential housing, and recreational activities (fishing, boating, hunting, and golfing) in the future. Future land use is best predicted by the PICA Real Property Vision Plan and two Development Plans (ECC 2020).

It is expected the facility and land use will continue to be operated and maintained by the Army for the foreseeable future. PICA is not closed to the public, but access to the Arsenal is controlled. Trespassing and unauthorized activities on Picatinny are illegal (USAEC 2020).

2.4 Climate

Northern New Jersey is characterized by a temperate, continental climate with warm summers and cold winters. Based on observations at the Boonton reporting station, overnight average daily low temperatures range from 18 degrees Fahrenheit (°F) in January to 62 °F in July. Daytime average daily high temperatures range from 35 °F in January to 83 °F in July. Rainfall averages 48 inches and is evenly distributed throughout the year. Ponds begin ice cover formation in December and are free of ice by the end of March (ECC 2020).

2.5 Topography

The New Jersey Highlands physiographic province, where PICA is located, is between the Appalachian Piedmont physiographic province to the southeast and the Valley and Ridge province to the northwest. The New Jersey Highlands Region is part of the larger New York-New Jersey Highlands, which encompasses 1.1 million acres of Appalachian ridges and valleys stretching from the Hudson River to the Delaware River (ECC 2020).

PICA encompasses a wide central valley (Picatinny Valley) that is approximately seven miles long, and a narrower parallel intermontane valley (Green Pond Gorge) about two miles long. The total breadth across PICA averages one mile. PICA is situated between Green Pond Mountain on the northwest, Copperas Mountain on the east, and an unnamed hill on the southeast. Overall, the dominant topographic gradient is from the northeast to the southwest with severe slopes present along the northwestern boundary of PICA along Green Pond Mountain, as well as gentler slopes on the eastern boundary of PICA (**Figure 2-3**) (ECC 2020).

The majority of PICA appears on the Dover U.S. Geological Survey topographic quadrangle. Elevations on PICA range from 685 feet above mean sea level in the valley to 1,287 feet above mean sea level along the ridgeline of Green Pond Mountain. In general, elevations are lower to the south and east and higher to the north and west. Refer to **Figure 2-3**.

2.6 Geology

PICA is located in the New Jersey Highlands physiographic province. The New Jersey Highlands are composed of Proterozoic to Devonian rocks as part of the Appalachian Mountains formed when the continents collided. Four bedrock formations underlie PICA: Precambrian gneiss and other metamorphic rocks, Cambrian Hardyston quartzite, Cambrian Leithsville dolomite, and Silurian Green Pond conglomerate. Unconsolidated Pleistocene-aged glacial till and stratified drift overlie much of the formations. Rocks with highly oxidized iron content are prevalent. Iron ore was extensively mined in the region (Lucey 1972).

The soils at PICA are acidic and primarily derived from glacial deposits. The central portion of PICA has soils that consist of loamy, silty, and gravel clay pan soils along with swampy areas that consist of peat and muck. The southern end of PICA consists of poorly sorted sands, gravels, and boulders bordered by a terminal moraine. To the northwest is a mountain range (Green Pond Mountain) with rough, stony land that formed on jagged, rocky slopes. Glacial till blankets the western and eastern flanks of PICA. Up to 20 feet of glacial till consisting of sand, gravel, and boulders covers the western portion of PICA. The eastern

portion of PICA consists of more uniform glacial till with thicknesses ranging from 10 to 25 feet. The valley floor consists of till and drift from glacial lakes and streams with a thickness of up to 200 feet (Dames & Moore 1991).

2.7 Hydrogeology

Hydrogeology of PICA consists of an unconsolidated and bedrock groundwater aquifer system that is defined by the ridges and main valley. The groundwater flow system for the majority of PICA is dominated by a central valley that consists of glacial deposits consisting of stratified drift underlain by bedrock with the ridges consisting mainly of glacial till overlying bedrock. The AOPIs identified during the PA and investigated in this SI are mainly located within the Valley portion of PICA, with a few AOPIs that are located along the ridges present at the installation.

The valley aquifer system at PICA is present in four distinct aquifers. The uppermost aquifer is an unconfined aquifer consisting of stratified drift on top of fine sand and silt lake sediments and has a thickness of 20 to 35 feet. Groundwater within this unit occurs from relatively near ground surface to about 30 feet below ground surface (bgs). Groundwater in the unconfined aquifer generally flows toward surface water discharge areas, such as Green Pond Brook (GPB), Bear Swamp Brook, and Lake Picatinny (**Figure 2-2**). Two semi-confined glacial till aquifers (upper and lower) consisting primarily of sand and gravel separated by silt, fine sands, and clay from the upper most unconfined aquifer, are present (Dames & Moore, 1991). The upper semi-confined aquifer is generally encountered in the southern half of the valley. The lower semi-confined aquifer occurs beneath the upper aquifer only in the central valley portion of this area. Groundwater flow direction in the semi-confined aquifers is generally down valley to the southwest and towards surface water discharge areas. Vertical flow is typically upward towards discharge areas except where affected by groundwater withdrawal wells. These three valley-fill aquifers (unconfined, upper semi-confined, and lower semi-confined) have a maximum thickness of approximately 175 feet. The semi-confined glacial till aquifers are the primary water source for PICA. The fourth and deepest aquifer is a bedrock aquifer separated from the confined glacial till aquifer by weathered bedrock with a maximum thickness of 60 feet (Dames & Moore 1991). Groundwater flow in the bedrock is generally towards the central valley and surface water features; however, locally the foliation and fracturing can alter and control flow directions along fractures and fault planes.

Along the broad topographic ridge, a number of smaller valley systems exist that transverse roughly east and west across the areas. These smaller valleys connect to valleys to the east or to the west that trend northeast to southwest. Groundwater in these valleys flows in overburden glacial till and alluvium and the underlying crystalline bedrock. Two AOPIs (Building 3801 – New Jersey Army National Guard (NJARNG) Helipad Area and Lawn to the North of Building 3409/3410) are located south of Lake Denmark, near Snake Hill Road. Based on previous investigations (IT Corporation 2001), overall topography and surface water direction groundwater from these areas flows eastward toward the eastern portion of the installation and will flow along the valley slopes to the valley bottom. A review of water levels in available monitoring wells on PICA confirm that the overall groundwater flow, in both the unconsolidated and bedrock aquifers, roughly matches the topography. Refer to **Appendix C** for a memorandum summarizing the flow information. Based on the steep topography off the eastern portion of the installation, it is assumed that unconsolidated and shallow bedrock groundwater flow will likely be confined to the valley with flow towards and along Ames Brook toward Ames Lake. It is expected that off-site groundwater flow in the

bedrock aquifer will also continue to roughly match the topography (IT 2001). Groundwater flow from the Picatinny eastern boundary is not expected to flow up valley toward Lake Telemark.

Groundwater flow information near Lake Denmark was obtained from the Remedial Investigation report for the Radiation Technology Incorporated Superfund Site, which is located immediately east of the northern portion of Lake Denmark. According to the Radiation Technology Incorporated Remedial Investigation there are two hydrologic basins separated by a northeast-southwest bedrock ridge along Lake Denmark Road. West of the bedrock ridge groundwater flows toward Lake Denmark in both the overburden and bedrock (CRA 2010). Refer to **Appendix D** for pertinent pages of this report describing groundwater flow direction.

2.8 Surface Water Hydrology

PICA lies within the recharge area of the New Jersey Watershed Management Area 6, the primary water supply for northern New Jersey. Surface water drains primarily from northeast to southwest with GPB serving as the primary drainage for PICA (**Figure 2-2**). GPB originates at a 500-acre spring-fed lake known as Green Pond, located adjacent to the northern border of PICA. All drainages from GPB leaving PICA empty into the Rockaway River, approximately one mile south and east of PICA. Rockaway River is the major tributary to the Boonton Reservoir, located approximately 10 miles southeast of PICA, and used as the Jersey City water supply (Weston 2014).

Main waterbodies within the installation include GPB, several unnamed small ponds, Bear Swamp Brook, Picatinny Lake and Lake Denmark. Approximately one mile south of PICA, GPB joins the Rockaway River. The Rockaway River flows east through the Boonton Reservoir before joining the Passaic River. Bear Swamp Brook joins GPB on the southern end of PICA. Ames Brook as well as the Hibernia Brook tributary flow off PICA exiting along the eastern boundary and join Lake Ames (**Figure 2-2**). Lake Denmark and Picatinny Lake are man-made features that collectively comprise 360 acres of open water. The lakes were constructed in the 1880s and are primarily used for industrial water supply and recreation (Weston 2014).

GPB is the main surface water drainage pathway within the valley. Two man-made lakes (Lake Denmark and Picatinny Lake) are present, both drained by GPB. Two tributaries to GPB, Robinson Run and Bear Swamp Brook, flow from the ridges on the southeast and northwest sides of the valley, respectively. Finally, wetlands and transition zones around the brooks are present throughout PICA (Weston 2014).

2.9 Relevant Utility Infrastructure

The following subsections provide general information regarding the installation's stormwater and wastewater management systems, as well as information on how the utility infrastructures may influence the fate and transport of PFAS at PICA.

2.9.1 Stormwater Management System Description

Storm water drainage at PICA is controlled through three dams and an extensive network of surface and subsurface conduits and culverts. The principal drainage channels flowing through improved grounds on the installation are the lower reaches of GPB and the middle and lower reaches of Bear Swamp Brook.

2.9.2 Sewer System Description

Sanitary wastewater generated from PICA is conveyed via gravity mains and pumping stations to the Rockaway Valley Regional Sewage Authority. The WWTP formerly operating at Building 80 was demolished in 2011 (Renova Environmental Services 2017).

2.9.3 Water Supply System Description

As indicated in the PA, water mains at PICA leaked an estimated 31 million gallons per year for an uncertain amount of time. The system consists of over 220,000 feet of piping and was replaced by slip lining the pipes in 2008 (**Figure 2-4**). Prior to the repair, the leaky water mains may have resulted in widespread groundwater mixing of PFAS across PICA (Arcadis 2019c).

2.10 Potable Water Supply and Drinking Water Receptors On-Post

Currently, there are two active on-post potable water wells located south of Picatinny Lake and relatively central on the installation, PW-131 and PW-302D (**Figure 2-2**). These on-post wells supply potable water to personnel such as workers and residents at PICA. Potable well PW-131 is 196 feet deep and draws water from the glacial aquifer. PW-302D is 403.5 feet deep and draws water from bedrock[2]. Refer to Section 2.12 for additional information. A third well, 410, is permitted but not currently used. PW-410, which is 108 feet deep and draws water from the glacial aquifer, is only used for emergency water supply.

2.11 Ecological Receptors

Due to the availability of adequate toxicity data, the Army focused the PA/SI on human receptors. The PA team collected information on ecological receptors that was available in the installation documents reviewed during the PA process. The following information is provided for future reference should the Army decide to evaluate exposure pathways relevant to the ecological receptors.

PICA is approximately 70 percent forested and contains over 4,000 acres of forested land. While there are no federally threatened or endangered plants known to exist on PICA, there are seven state listed endangered plants, as well as 16 state species of concern on PICA. One federally listed endangered mammal (Indiana bat) and two federally listed threatened animals (northern long-eared bat and bog turtle) occur at PICA (U.S. Fish and Wildlife Service, 2016). In addition, 15 state listed endangered species are known to occur on the Arsenal: one snake, three mammals, one turtle, and 10 birds (ECC 2020).

2.12 Previous PFAS Investigations

The samples described in this section were collected by entities other than the Army. These data are included in this report for completeness; however, these data were not used to make any decisions in this SI.

In 2013, under the third Unregulated Contaminant Monitoring Rule, groundwater samples were collected from the existing Building 1383 Water Treatment Plant. Samples were collected by the USEPA from the

[2] Refer to http://www.amwater.com/ccr/picatinnyarsenal.pdf, last accessed June 2, 2020.

point of entry into the distribution system and were analyzed for various parameters, including PFOS and PFOA. Analyses of these samples indicated that PFOS and PFOA were not detected; the limit of detection (LOD) was 40 and 20 ng/L for PFOS and PFOA, respectively.

Because laboratories are able to achieve lower detection limits, in 2018 additional PFOS and PFOA samples were collected by the water purveyor, American Water from on-post potable wells PW-131 and PW-302D, which have been used to supply on-post drinking water for many years. These results were repeated a number of times by both American Water and the Army and were above the LHA of 70 ng/L for the sum of PFOS and PFOA. Because the concentrations exceeded the LHA, the Army and the water purveyor, American Water, took the following actions.

- On 6 April 2018, Lieutenant Colonel Ivey informed the residents and workers at PICA that bottled water would be supplied to everyone. By 10 April 2018, PICA residents and employees were provided bottled water for all domestic uses.
- In May 2018 American Water installed a granular activated carbon (GAC) system for the removal of PFAS. That GAC system contains two vessels, operating in series.
- The new WTP was placed into service on May 18, 2020. It includes GAC with coconut shell.
- Since May 2018 American Water has been conducting quarterly monitoring of the water, prior to and after GAC treatment. A data table summarizing the quarterly results, along with the laboratory summary sheets, are included in **Appendix E**.

3 AOPIs

Overviews for each AOPI identified during the PA process are presented in this section. These AOPIs were sampled during either the pre-SI or SI sampling events, as discussed in **Sections 5.1, 5.2, and 5.3**. Refer to **Figure 3-1** for the AOPI locations.

3.1 Building 169 – Firehouse 1

Building 169 – Firehouse 1 was identified as an AOPI due to AFFF use related to firehouse operations. Building 169 – Firehouse 1 is the most recently constructed firehouse currently utilized by the PICA Fire Department, built approximately 10 years ago. Over the past 10 years, an estimated 55 gallons of AFFF have been released during nozzle testing and hose cleanouts at this location. Nozzle testing and hose cleanouts within the firehouse bays and parking lot could have resulted in AFFF release in this area (**Figure 3-2**). Firetrucks that stored AFFF were also washed and housed in the parking lots and internal bays at this firehouse. During site reconnaissance at Building 169 – Firehouse 1, the Picatinny Fire Chief stated that AFFF was released into the floor drains within the building bays during fire truck tank cleanouts and fire truck washing. AFFF rinses released to these floor drains within the bays were conveyed to the WWTP via the sanitary sewer system (Arcadis 2019c).

Under the Installation Restoration Program (IRP), the groundwater under Building 169 - Firehouse 1 is located within the boundary of PICA-204 which addresses Mid-Valley Groundwater. The firehouse is not included in any IRP sites (PICA 2019).

3.2 Building 3316/3321 – Firehouse 2 (PICA-189 / 34855.1155)

Building 3316 – Firehouse 2 was identified as an AOPI due to AFFF use related to firehouse operations. Approximately 10 years ago, prior to the construction of Firehouse 1, Building 3316 – Firehouse 2 was historically used as the sole fire department at PICA. Building 3316 - Firehouse 2 still operates as an active firehouse and is the location of fire truck storage and fire department operations. Historical operations included fire truck storage and washing, AFFF fueling operations, and nozzle testing. Nozzle testing at Building 3316 – Firehouse 2 resulted in AFFF release within the parking lot with potential for runoff to surrounding soils (**Figure 3-3**). An estimated 55 gallons of 3 to 6% AFFF were released in this area (Arcadis 2019c).

An additional building, Building 3321 – Warehouse Storage Facility, which is adjacent to Building 3316 – Firehouse 2 and used by the PICA Fire Department for storage, was not identified as an AOPI in the PA due to lack of access to the environment (i.e., there are no floor drains and the floor is sealed). This building is currently used to store AFFF in either 55-gallon drums or smaller closed containers. During the PA site reconnaissance, approximately one dozen 55-gallon drums of AFFF were stored in Building 3321. According to the PICA Fire Department, at an unknown date approximately 10 gallons of AFFF leaked from one of the drums. The leak was contained and cleaned. Because of a reinterpretation in Army protocol for warehouses where AFFF is stored, Building 3321 is now considered an AOPI (Army 2018). Due to its proximity to Building 3316, and because this warehouse is used by the PICA Fire Department, Building 3321 has been incorporated into the Building 3316 – Firehouse 2 AOPI and the name has been changed from the PA.

As part of the IRP, Building 3316 was associated with IRP site PICA-189, which was closed out in June 2003. Building 3321 is not associated with any IRP Sites (PICA 2019).

3.3 Former Pyrotechnic Area and Sanitary Landfill (PICA-066; PICA-205 / 34855.1033; 34855.1170)

The Former Pyrotechnic Area and Sanitary Landfill was identified as an AOPI due to AFFF use related to historical fire responses. Prior to 1990, AFFF was utilized once or twice a year by the PICA Fire Department to extinguish lingering fires on the peaty grounds associated with this area (**Figure 3-4**); it is unknown what specific product or volume of AFFF was released. In addition to confirmed AFFF use in the Former Pyrotechnic Area and Sanitary Landfill, historical landfilling activities at the Sanitary Landfill included dumping of sanitary waste, fly ash, ordnance, industrial wastes, and WWTP sludge. These landfilling wastes could also potentially contribute to PFAS release in this area (Arcadis 2019c).

As part of the IRP, the Former Pyrotechnic Area and Sanitary Landfill are addressed under PICA-066 for soils and PICA-205 for groundwater due to past landfilling operations. PICA-205 addresses Area B groundwater associated with the Former Pyrotechnic Area and Sanitary Landfill. In addition to land use controls (LUCs) and cap maintenance, the Former Pyrotechnic Area and Sanitary Landfill also are in the long-term monitoring phase (LTM) phase and Area B Groundwater is in the RA-O phase. (PICA 2019).

3.4 Former Lower Burning Grounds (PICA-002 / 34855.1002)

The Former Lower Burning Grounds was identified as an AOPI due to AFFF use related to historical fire responses. The PICA Fire Department used AFFF intermittently in this area (**Figure 3-5**) to extinguish lingering fires due to difficulty associated with extinguishing fires on the peaty grounds in this area. The specific AFFF used, and overall volume used over time, are unknown. The majority of these responses involving AFFF happened prior to the early 1990s (Arcadis 2019c).

As part of the IRP, the Former Lower Burning Grounds is addressed under PICA-002 due to historic burn area uses. In addition to the placement of an asphalt cap, soil cover and wetland mitigation, requirements of the remedial design for PICA-002 include groundwater and surface water monitoring, land use certifications, and maintenance of the cap and cover. The site is currently in the LTM phase (PICA 2019).

3.5 Area 1222 - Gorge

Area 1222 – Gorge was identified as an AOPI due to AFFF use related to historical fire responses. Prior to 1988, the PICA Fire Department used AFFF periodically to extinguish fires that started due to the munitions testing activities that occur in this area (**Figure 3-6**). It was noted that large volumes of AFFF were used in this area, but at a 1% concentration. AFFF was used due to the difficulty in extinguishing fires on the rocky topography associated with this area (Arcadis 2019c).

This area is not included in any IRP sites (PICA 2019) but is monitored and regulated under RCRA Subpart X interim status as a treatment area.

3.6 The Lawn to the North of Building 3409/3410

The Lawn to the North of Building 3409/3410 was identified as an AOPI due to AFFF use related to training operations. In the early 2010s, the Lawn to the North of Building 3409/3410 was used by the PICA Fire Department on multiple occasions as a location of AFFF training activities such as arc training and nozzle testing. Arc training and nozzle testing do not involve live fire training, but test capabilities of fire response equipment and foam coverage. An estimated 60 gallons of AFFF at a 3 to 6% concentration were released due to training in this area and were concentrated on the grassy and wooded portions (**Figure 3-7**) (Arcadis 2019c). This area is not included in any IRP sites (PICA 2019).

3.7 Former Building 24 (PICA-076 / 34855.1043)

Former Building 24 was identified as an AOPI due to historical chromium plating operations. The chromium plating operations at Former Building 24 began in approximately 1942 and continued until about 1982. Former wastewater lagoons associated with Former Building 24 operations received process wastewater that could have potentially contained PFAS-containing wastes from chromium plating mist suppressants. These wastewater lagoons were clay-lined until 1981; therefore, they had the potential to release PFAS to the environment. In addition, PFAS releases related to Former Building 24 operations could be released into the Bear Swamp Brook, which runs adjacent to each former structure and received effluent process wastewater. Former Building 24 and its associated lagoons have since been demolished (**Figure 3-8**) (Arcadis 2019c).

As part of the IRP, Former Building 24 groundwater and surface water is addressed under PICA-076 due to former chromium plating activities and associated wastewater lagoons at the site. The Record of Decision for PICA-076 Area D Groundwater included the shutdown of an interim pump and treat system, installation of a permeable reactive barrier, as well as monitored natural attenuation sampling of groundwater and surface water. Remedial Action Operations are ongoing, with annual reports being submitted (PICA 2019).

3.8 Post Farm Landfill (PICA-065) / 34855.1032)

The Post Farm Landfill was identified as an AOPI due to the relation to chromium plating wastes. It was indicated that drums found at the Post Farm Landfill came from Former Building 24, as well as other buildings. Due to the potential for operations at Former Building 24 to involve PFAS-containing mist suppressants, it is possible that wastes disposed here contained PFAS. Beginning in the 1940s through 1979, the Post Farm Landfill received a variety of industrial waste generated at PICA, including fly ash, paint stripping wastes, phenols, and spent explosive laden hydraulic oils. In addition to the chromium plating-related wastes, spent hydraulic oils and paint sludges could potentially be a secondary source of PFAS as well (**Figure 3-9**). It should be noted that in 1993 a removal action was performed at the landfill and 390 drums, 38 cubic yards of soil, and 30 cubic yards of scrap steel were removed. The ROD for PICA-065 also included the placements of LUCs for soil (PICA 2004). (Arcadis 2019c).

Under the IRP, the Post Farm Landfill is addressed under PICA-065 due to historical landfilling operations. Groundwater is monitored as part of the LTM phase (PICA 2019).

3.9 Former Wastewater Treatment Plant Facility (PICA-070 / 34855.1037)

The Former WWTP Facility was identified as an AOPI due to the possibly of AFFF rinse reaching the WWTP via the sanitary sewer system. During the PA site reconnaissance, Arcadis noted sanitary sewer drains proximal to AFFF release locations. In addition, the PICA Fire Chief stated that AFFF was released into the floor drains at Building 169 – Firehouse 1, within the building bays during fire truck tank cleanouts and fire truck washing. AFFF rinses released to these floor drains within the bays were conveyed to the WWTP via the sanitary sewer system. At Building 3801 – NJARNG Helipad Area, Arcadis noted a sanitary sewer manhole in the grassy area downgradient of AFFF fire response release on the helipad that could have potentially captured AFFF rinse and been conveyed to the WWTP. Although the facility building was demolished in 2011, the Former WWTP Facility and the associated sludge beds (**Figure 3-10**) could potentially be a secondary source of PFAS due to AFFF-related wastes received (Arcadis 2019c).

Under the IRP, the Former WWTP Facility and sludge beds were addressed with PICA-070. The site has been listed as Response Complete and has LUCs in place for soils (PICA 2019).

3.10 Building 3801 – New Jersey Army National Guard Helipad Area (PICA-096 / 34855.1062)

Building 3801 – NJARNG Helipad Area was identified as an AOPI due to AFFF use related to a historical fire response. In 1988 or 1989, the PICA Fire Department utilized AFFF to respond to a fire that occurred on a concrete slab adjacent to Building 3801 at the NJARNG Helipad area. The fire occurred due to a static electricity spark during a vehicle fueling operation. Approximately 20 gallons of 3 to 6% AFFF were used to extinguish the fire and were released directly on the concrete pad, with potential for migration to surrounding soils (**Figure 3-11**).

As part of the IRP, Building 3801 – NJARNG Helipad Area is addressed under PICA-096, a consolidated site. This site has LUCs in place and is in the LTM Phase (PICA 2019).

4 SUMMARY OF SI ACTIVITIES

Based on the results of the PA at PICA, a pre-SI and SI for PFAS was conducted in accordance with CERCLA. Sampling was completed at PICA at all of the AOPIs to evaluate presence or absence of PFAS. As such, installation-specific QAPP Addenda (Arcadis 2018b; Arcadis 2019c) were developed to supplement the general programmatic information provided in the PQAPPs (Arcadis 2018c; 2019b) and to detail the site-specific proposed scopes of work for the pre-SI and SI. A preliminary CSM was prepared for each of the installation's AOPIs in accordance with the USACE Engineer Manual on Conceptual Site Models, EM 200-12 (USACE 2012). The preliminary CSMs identified potential human receptors and chemical exposure pathways based on current and/or reasonable anticipated future land use. The soil, groundwater, surface water, and sediment pathways were identified as complete or potentially complete for all AOPIs. The QAPP Addenda detail the sampling design and rationale based on each AOPI's preliminary CSM as noted in the PA (Arcadis 2019c). The on-post pre-SI sampling occurred in September 2018. The off-post pre-SI sampling was conducted in May, July, and August 2019. The SI scope of work was completed between November 2019 and March 2020.

The SI field work was completed in accordance with the standard operating procedures (SOPs), technical guidance instructions (TGIs), sampling design, and QA/QC requirements as detailed in the QAPP Addenda (Arcadis 2018b; Arcadis 2019d) and PQAPPs (Arcadis 2018c; 2019b). The subsections below summarize the DQOs, sampling design and rationale, sampling activities and methods, and data analyses procedures for the pre-SI and SI phase at PICA. Non-conformances to the prescribed procedures in the PQAPPs and QAPP Addendum are described in **Section 4.4.3**. Analytical results obtained through SI field activities are summarized in **Section 5**.

4.1 Data Quality Objectives

As identified during the DQO process, and outlined in the site-specific QAPP Addenda, (Arcadis 2018b; Arcadis 2019d), the objective of the pre-SI and SI was to evaluate whether there has been a release to the environment from any of the AOPIs identified. This SI evaluated groundwater, soil, and surface water for PFOS, PFOA, PFBS presence or absence at each of the sampled AOPIs. Upgradient/upstream on-post locations were also sampled to determine the potential for upgradient off-post PFAS sources to be present. Note that the RTI Superfund Site is located upgradient of the eastern boundary of PICA. Additionally, private potable water supply wells were researched, located, and sampled to identify potential off-site human receptors and the potential for PFAS to migrate from PICA to downgradient, off-post locations.

4.2 Sampling Design and Rationale

The rationale for sampling at each AOPI is illustrated on **Figure 4-1** below.

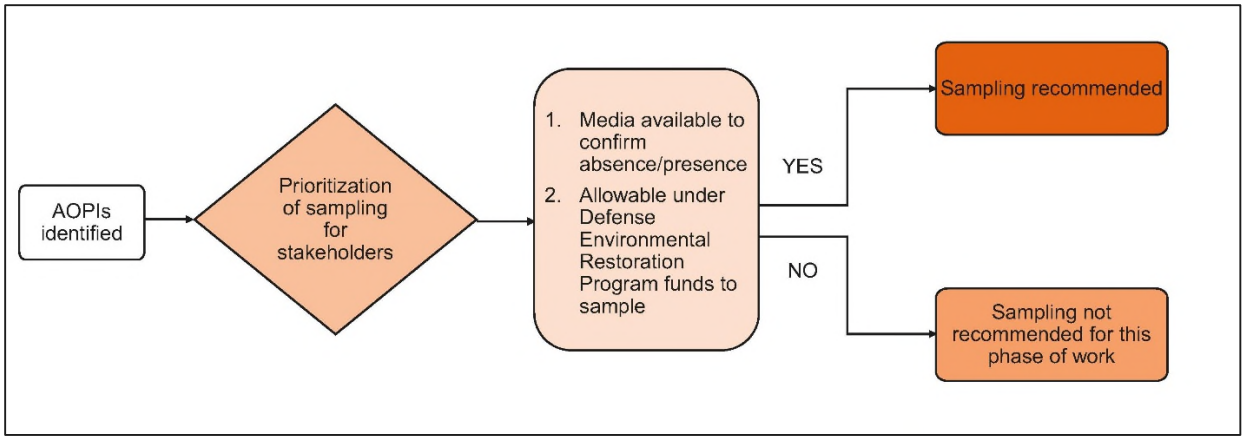


Figure 4-1: AOPI Sampling Decision Tree

The sampling design for pre-SI and SI sampling activities at PICA are detailed in Worksheets #17 of the QAPP Addenda (Arcadis 2018b; Arcadis 2019d). Briefly, the areas of focus for this SI were selected based on a review of historical documents and data and information obtained by conducting personal interviews during the PA (Arcadis 2019c). Approximate sampling depths, and constituents analyzed for each sampling location and medium are included in **Table 4-1**. Sampling depths noted for existing monitoring wells represent approximately the center of the saturated screened interval. The sampling design rationale for the pre-SI and SI include the following.

- Pre-SI – Groundwater and surface water samples were collected to identify PFAS presence, type, and concentrations both on and off-post. The AOPIs targeted for sampling represented areas near the southern boundary believed to have the greatest potential for groundwater to migrate off-installation. Downgradient locations targeted for sampling were located at the southern boundary of PICA and were selected to represent the potential for PFAS to be migrating off-post. The off-post samples were collected from private wells located downgradient of the southern boundary of PICA. As part of the pre-SI, the locations of potential off-post private wells located within one mile downgradient of PICA's southern boundary were identified.
- SI – Groundwater samples were collected to determine PFAS distribution and migration and update the CSMs. Surface water samples were collected to inform the presence or absence of PFAS in surface water and update the CSMs. Soil samples were collected to evaluate the potential for those media to be sources of PFAS to surface water and groundwater, as well as identify inform the interpretation of PFAS distribution, determine residual source strength of potential PFAS release areas, evaluate the potential for those areas to be sources of PFAS to surface water and groundwater as an influence to drinking water, and update the CSMs. As part of the SI, the potential for off-post private wells to be located downgradient of PICA's eastern boundary was investigated.

Approximate sampling depths and constituents analyzed for each sampling location and medium are included in **Table 4-1**. Sampling depths noted for existing monitoring wells represent approximately the center of the saturated screened interval.

4.3 Off-Post Potable Well Identification

4.3.1 Potential Private Wells Southern Boundary

Off-Post potential private potable wells located downgradient of groundwater wells located on PICA's Southern Boundary where concentrations of PFAS above EPA LHA were found were identified using the steps detailed below.

1. Well information contained in the Environmental Data Resources (EDR), Inc. report[3] was mapped and reviewed.
2. Information on potential well locations downgradient of PICA was requested online through a well radial search via the New Jersey Department of Environmental Protection (NJDEP) DataMiner XY Well Search[4]. Because PICA has an irregular shape, information was requested using multiple locations along the PICA boundary.
3. The results of the NJDEP well radial search were reviewed to reduce the wells to those not owned by PICA and that were potentially active (i.e., wells not identified as abandoned, decommissioned, or owned by PICA).
4. Well permits for the remaining wells were requested from NJDEP. Once the permits were received, the location information provided on the well permit was reviewed to locate the well in the search area. This step was complicated by the locations given on the permits. For example, in some cases northings/eastings were given but in many other cases only the road name and not the actual address was given. Therefore, tax records were cross-checked against the owner's names or other property location identifiers such as property block and lot. Redacted well permits are included in **Appendix F**[5].
5. Local water providers and health departments were also contacted to determine what properties, if any, within the downgradient area were not known to be connected to public water.
6. All of the information obtained was compared to develop a list of properties that could potentially be on private water.
7. Letters were sent to the owners of the properties identified as potentially having a private well. The letter included a questionnaire for the owners to complete and send back.
8. If the questionnaire was not returned, a door-to-door survey was conducted and, if the owner or tenant was present, the presence or absence of the well, as well as its function (e.g., only used to water the lawn) was determined.

This process was performed on incremental basis. Initially, wells were identified within 0.1 mile downgradient of PICA. On 09 April 19 the area was expanded to 0.3 mile downgradient of PICA and on

[3] The EDR report is contained in the PA Report (Arcadis 2019c)
[4] The data miner information was obtained from the following website: https://www13.state.nj.us/DataMiner/Search/SearchByCategory?isExternal=y&getCategory=y&catName=Water+Supply+and+Geoscience.
[5] Because these wells are owned by private residents, addresses and blocks/lots were removed. Not all identified wells had NJDEP permits.

30 May 2019 PICA expanded the search to 1 mile downgradient of the southern boundary. If the Rockaway River was encountered prior to a mile, the river acted as the boundary. Altogether, 10 potential private potable wells were identified within one-mile downgradient of PICA's southern boundary (**Figure 4-2**). The presence of nine of the wells was confirmed; one well could not be confirmed because the owner could not be contacted. Seven property owners granted access to sample their wells; therefore, seven private off-post potable wells were sampled during the pre-SI.

4.3.2 Potential Private Wells Downgradient of Eastern Boundary

To determine the potential for off-post private wells to be located downgradient of the Building 3801 – NJARNG Helipad Area and Lawn to the North of Building 3409/3410, tax records for the area were reviewed in April 2020. Three properties were identified on the tax maps. Refer to **Figure 4-3** and **Appendix C**. Once the properties were identified, a well search was conducted via property address and current block and lot searches on the NJDEP well permits and information in online reports. No private potable wells were identified on the three properties. Refer to **Appendix C**.

1. Block 30101, Lot 1 – This is an approximately 286-acre lot, owned by Rockaway Township and classified as public land. This is currently used as Lake Ames Park and park buildings are reportedly located on the property.
2. Block 20001, Lot 6 – This is an approximately 80-acre lot, owned by Morris County and classified as vacant land. No buildings were identified on this property.
3. Block 20001, Lot 5 – This is an approximately 12-acre lot, owned by Rockaway Valley Environmental, which is categorized as qualified farmland. No buildings were identified on this property.

4.3.3 Public Potable Supply Wells

As shown in the PA, the EDR report[6] identified numerous off-post water supply wells surrounding PICA (Arcadis 2019c). However, as shown on **Figure 4-4**, only two public potable water supply wells were confirmed within one mile downgradient of PICA's southern boundary. These wells, owned by Wharton Borough, were confirmed by the Borough's utility supervisor and are located approximately 0.85 miles south of PICA. The wells have a single designation, TP001002, as both wells are connected to a single air stripping tower. In March 2019, samples were collected from these wells by the Wharton Water Department at the point of entry, prior to treatment. The samples were analyzed for a variety of compounds including PFOS, PFOA, and PFBS. PFOA was detected at 2.9 ng/L; PFOS and PFBS were not detected in the sample. The laboratory summary sheets are included in **Appendix E**.

As shown on **Figure 4-5**, one public potable well, owned by the Rockaway Township Water Department, was identified by EDR within one mile of the eastern boundary of PICA. Information on potential well locations downgradient of PICA was requested online through a well radial search via the NJDEP DataMiner XY Well Search. Based on the information received, the well identified by EDR as a Rockaway Township Water Department well is noted as an irrigation well, not a potable well. Refer to **Appendix F**.

[6] The EDR report is contained in the PA Report (Arcadis 2019c)

4.4 Sampling Methods and Procedures

Environmental data were collected and analyzed in accordance with the PQAPPs (Arcadis 2018c; 2019b), the SOPs and TGIs included as Appendix A to the PQAPPs, the QA/QC requirements identified in Worksheet #20 of the PQAPPs, the approved scope and sampling methods outlined in the site-specific QAPP Addenda (Arcadis 2018b; Arcadis 2019d), and the safety procedures specified in the Accident Prevention Plan (Arcadis 2018a), SSHP (Arcadis 2018b), and the SSHPs (Arcadis 2019a). The sampling methods described in the SOPs and TGIs establish equipment requirements, procedures for preparing equipment and containers before sampling, sampling procedures under various conditions, and procedures for storing samples to ensure that sample contamination does not occur during collection, and transport. In general, sampling techniques used for PFAS site characterization were consistent with conventional sampling techniques used in the environmental industry, but special considerations were made regarding PFAS-containing materials and equipment and cross-contamination potential.

The sampling methods employed during the pre-SI and SI are detailed in the PQAPPs (Arcadis 2018c; 2019b) and QAPP Addenda (Arcadis 2018b; Arcadis 2019d). The subsections below provide a summary of the field methods and procedures utilized to complete the pre-SI and SI scope of work. Field notes and field forms (i.e., soil boring logs, monitoring well inspection logs, groundwater purging logs, and sample collection logs) documenting the pre-SI and SI sampling activities, as well as photographs of the sampling activities, are included in **Appendix H**.

4.4.1 Field Methods

Prior to conducting any field work, all required work permits, including permits required by PICA as well as monitoring well permits, were obtained. Utility clearance was performed for all intrusive activities. This clearance including contacting the NJ one call system, having a geophysical surveyor survey a 10-foot radius around the boring location, and hand digging the first 5 feet for all temporary wells. An unexploded ordnance field technician also accompanied the field team, where appropriate, to clear the sample locations. With the exception of existing monitoring wells and private wells, the coordinates for all sample locations were recorded using a handheld global positioning system. All samples were collected into the appropriate container and placed on ice.

On-Post Monitoring Well and Temporary Well Point Groundwater Sampling

On-post groundwater samples were collected from both existing monitoring wells and temporary well locations. For both well types, samples were collected using low-flow sampling techniques. Peristaltic pumps were used for shallower wells and bladder pumps were used for deeper wells. The pumps were equipped with PFAS-free disposable high-density polyethylene tubing. As the wells were purged, water quality parameters were measured including pH, conductivity, turbidity, dissolved oxygen, and oxidation-reduction potential. Purging continued until the parameters stabilized, as described in the low-flow sampling SOP.

1. Existing Monitoring Wells – Prior to sampling, existing monitoring wells were inspected to determine if they were able to be sampled (e.g., undamaged casing). If dedicated tubing or pumps were in the well they were removed prior to purging. The samples were collected from approximately the center of the saturated screened interval.

2. Temporary Well Points – The temporary well-points were installed using a track-mounted rotary sonic drill rig. Temporary casing and a screen were installed, the well was purged until the turbidity stabilized, and the groundwater samples were collected from the mid-point of the screen. The well installation depth was field determined by the hydrogeologist.

Off-Post Private Potable Well Groundwater Sampling

The following steps were used to sample private wells.

1. Each owner granted permission to sample their well on the well questionnaire that they filled out prior to sampling.
2. The potential sample locations were inspected to identify the sample location that would provide the most representative data (e.g., closest to the well pump).
3. If present, fittings (e.g., aerator, diffuser) were removed from the sample location.
4. The tap was flushed for a minimum of five minutes prior to sampling.
5. Any pertinent information about the sample location (e.g., sample was collected from a tap with Teflon tape) was noted.

Soil Sampling

Soil samples were collected using the following two methods.

1. When soil samples were collocated with temporary well points, the samples were collected using rotary sonic methods. Dual-tube drill casing was advanced using a top down sampling method to minimize cross-contamination at depth and the soil samples were collected in PFAS-free acetate liners.
2. Soil samples collected without a rig were collected using a single-use PFAS-free trowel directly into the sample container.

Surface Water Sampling

Surface water samples were collected from downstream to upstream to reduce siltation in sequential samples. During sampling, field parameters (temperature, pH, conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential) were measured. The samples were collected from just below the water surface into the laboratory-supplied container using direct fill methods.

Decontamination procedures for non-dedicated equipment used during sampling are described in **Section 4.4.4**.

4.4.2 Quality Assurance/Quality Control

Worksheet #20 of the PQAPPs (Arcadis 2018c; 2019b) and QAPP Addenda (Arcadis 2018b; Arcadis 2019d) provide QA/QC requirements for field duplicates, matrix spike/matrix spike duplicates, equipment blanks (EBs), and field blanks (FBs) for laboratory-supplied water used in the final decontamination step. A source blank for water used to decontaminate drilling equipment was not required because analytical data from American Water are available (refer to **Section 2.12**) and these data do not indicate the presence of PFAS after treatment.

QA/QC samples were collected at the frequencies specified in the QAPP Addenda (Arcadis 2018b; Arcadis 2019d), typically at a rate of 1 per 20 parent samples. Field duplicates and matrix spike/matrix spike duplicate samples were collected for media sampled for PFAS only. EBs were collected for media sampled for PFAS at a frequency of one per piece of relevant equipment for each sampling event, as specified in the QAPP Addenda (Arcadis 2018b; Arcadis 2019d). The decontaminated reusable equipment from which EBs were collected include tubing, tubing weights, screen-point samplers, drill casing and cutting shoes, water-level meters, and acetate liners, as applicable to the sampled media. Analytical results for QA/QC samples are discussed in **Section 5.4**.

4.4.3 Field Change Reports

No instances of major scope modifications (i.e., those that may have had a significant impact on the project scope and/or data usability/quality, or required stop-work, and warranted discussion with the United States Army Corps of Engineers [USACE]) were encountered during the PICA pre-SI and SI work. In some cases, clarifications to the established scope of work may be needed but do not necessarily constitute a non-conformance from the sampling plans described in the QAPP Addendum. Minor modifications from and clarifications for the procedures and scope of work detailed in the QAPP Addendum and PQAPPs and that did not affect DQOs are documented in Field Change Reports included as **Appendix I** and are summarized below:

4.4.3.1 AOPIs

- General; During sampling six existing monitoring wells, (175MW-1 and 175MW-2 at the Building 3801 – NJARNG Helipad and MWs-26S, 27S, 28S, and 29S at the Eastern Boundary) dedicated Teflon tubing was present in the wells. When the PQAPP and QAPP Addendum were developed for the pre-SI, the method for addressing monitoring wells with dedicated sampling equipment was to remove the dedicated equipment, purge the well, sample the well with PFAS-free sampling equipment, and return the dedicated equipment back to the well. The subsequent SI PQAPP required the collection and analysis of a sample from the initial well volume purged to determine if the dedicated equipment could be affecting the sample results. A purge water sample was not collected from these wells. Based on results from the AOPI samples, the dedicated tubing did not appear to have an impact on the groundwater results. For example, three of the four wells sampled on the Eastern Boundary (MWs 26S, 28S, and 29S) had a maximum detection of 4 ng/L for PFOS/PFOA combined; MW-27S had a detection of 126.7 ng/L for PFOS/PFOA combined. Therefore, this modification does not affect the data.
- Off-Post Potable Wells; The SOP for the collection of potable groundwater samples requires analysis via USEPA Method 537.1; the samples were analyzed via USEPA Method 537. USEPA Method 537 requires the reporting of four compounds that are not reported using Method 537.1; 6:2 fluorotelomer sulfonate, 8:2 fluorotelomer sulfonate, perfluorobutanoic acid, and perfluoropentanoic acid. Both methods are approved USEPA analytical methods that meet the DQOs. Therefore, this modification does not affect the data.
- General; Originally, all the soil samples were to be analyzed for total organic carbon, pH, grain size, and moisture. This was modified so that one soil sample from each AOPI was analyzed for

these parameters. Because these data were collected for potential use in future fate and transport studies, this modification does not affect the SI decision making process.

- Building 3316/3321; Firehouse 2; During the well inspection, MW 3316-1 (70 feet deep) was observed to be damaged; therefore, groundwater samples could not be collected. Two other groundwater samples were collected from this AOPI (one monitoring well and one temporary well point; these wells are approximately 20 and 25 feet deep, respectively). Therefore, there are sufficient data to inform the SI decision.
- Former Lower Burning Ground –
    - Pre-SI Sampling Event; – MWs 1179-3 (19.3 feet deep[7]), 1179D-1 (originally noted as 19.5 feet deep), and 1181-3 (24.6 feet deep) were originally proposed to be sampled. However, MWs 1179-3 and 1181-3 could not be located during the sampling event and were later found to have been abandoned. In addition, 1179D-1 was listed as 19.5 feet deep, but when sounded prior to sampling it was observed to be 157 feet deep, and therefore, outside the targeted sample zone. Instead, MWs 1179A-1 (21.7 feet deep), 1179A-2 (18.6 feet deep), and 1179-1 (52 feet deep), were sampled. As the replacement wells are proximal to the originally proposed wells and are located in the planned aquifer for sampling, this change does not affect the DQOs.
    - SI Sampling Event; TW-1 could not be installed because there was no access across GPB and because the proposed sample area is a swamp that would likely not support the weight of the rig. Therefore, the installation of temporary well TW-1 and the collection of soil samples from SO-01 could not be completed.

      These changes did not affect the DQOs because five groundwater samples and a surface water sample were collected from this AOPI. Therefore, there are sufficient data to inform the SI decision.
- Area 1222 – Gorge; TW-6 could not be installed because there was no safe access to the sample location. Therefore, the installation of temporary well TW-6 and the collection of a deep soil sample from SO-06 could not be completed.

  These changes did not affect the DQOs because a shallow soil sample was collected from SO-06 and three groundwater samples were collected from this AOPI during the SI. Therefore, there are sufficient data to inform the SI decision.
- Former WWTP Facility;
    - During the well inspection, MW 80-2 (16.8 feet deep) was observed to be damaged; therefore, groundwater samples could not be collected.
    - The deeper soil sample could not be collected from SO-02 because terrain issues prohibited drill rig access to the proposed sample.

  These changes did not affect the DQOs because a shallow soil sample was collected from SO-02 and five groundwater samples were collected from this AOPI during the pre-SI and SI, including

[7] Monitoring well depths listed here are the depths recorded in PICA monitoring well documentation.

one sample from a monitoring well with a depth of 16.8 feet. Therefore, there are sufficient data to inform the SI decision.

4.4.3.2 Other Sampling Areas

- Northern Boundary;
    - TW-7 could not be installed due to safety concerns (i.e., located adjacent to numerous magazines)
    - TW-8 could not be installed because the only viable sample location was on a bedrock outcrop
    - SW-11 was collected further south than originally planned because the original location was inaccessible

  These changes do not affect the DQOs because these samples are not associated with an AOPI and, therefore, are not used to inform the SI decision.

4.4.4 Decontamination

Non-dedicated reusable sampling equipment (e.g., drill cutting shoes and casing, screen-point samplers, water-level meters) that came into direct contact with sampling media was decontaminated before first use, between sampling locations/intervals, and before demobilization in accordance with P-09, TGI - Groundwater and Soil Sampling Equipment Decontamination (Arcadis 2019b). With the exception of the drill rig casings and tooling, the sampling equipment were single-use, non-PFAS containing equipment. Therefore, the only decontamination steps employed were the following:

Remove loose dirt/debris from sampling equipment

Pressure wash or steam-clean drive casings and other drilling tooling

Rinse two times with deionized or distilled water

Rinse one time with laboratory-supplied PFAS-free water

In accordance with NJDEP regulations the decontamination water was reapplied directly to the ground surface in the area where the sampling took place (NJDEP 2005). Decontamination solutions were not reused between locations.

4.4.5 Investigation-Derived Waste

Investigation-derived waste (IDW), including soil cuttings and groundwater were disposed on the ground at the point of collection. Initially, during the pre-SI the purge water was containerized in drums, in accordance with USAEC guidelines. The water from each well was placed in separate drums. However, these guidelines were subsequently modified so that the disposal requirements of the state regulatory agency would be followed. Refer to **Appendix J**. Therefore, the drummed water was brought back to the well it was purged from and placed on the ground surface. The purge water removed from the well during the SI sampling event was pumped directly to the ground surface. Equipment IDW was collected in bags and disposed in on-post waste receptacles. Equipment IDW includes personal protective equipment and

other disposable materials (e.g., gloves, plastic sheeting, Lexan tubes, and high-density polyethylene and silicon tubing) that may come in contact with sampling media.

4.5 Data Analysis

The subsections below summarize the laboratory analytical methods and the methodology used to evaluate data collected during the SI through data verification and usability assessments (as completed by an Arcadis project chemist, independent of the project team).

4.5.1 Laboratory Analytical Methods

Analytical samples collected during the SI were submitted to Eurofins Lancaster Laboratories Environmental, an NJDEP-certified and ELAP-accredited laboratory for PFAS analysis. Laboratory analyses associated with the SI were completed in accordance with Worksheets #12.1 through #12.5 in the PQAPP (Arcadis 2019b). Eighteen PFAS-related compounds (listed in **Table 4-2** below) were analyzed for in groundwater, soil, surface water, and potable water samples using a PFAS analytical method that is ELAP-accredited and compliant with QSM 5.1.1, Table B-15 (DoD 2018). Copies of laboratory analytical reports generated during the pre-SI and SI are included as attachments to the Data Usability Summary Report (DUSR) in **Appendix K**.

Table 4-2. PFAS Compounds Analyzed in Groundwater, Soil, Surface Water, and Potable Water

Chemical Name	Chemical Abbreviation
6:2 Fluorotelomer sulfonate	6:2 FTSA
8:2 Fluorotelomer sulfonate	8:2 FTSA
N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA
N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA
Perfluorobutanesulfonic acid	PFBS
Perfluorobutanoic acid	PFBA
Perfluorodecanoic acid	PFDA
Perfluorododecanoic acid	PFDoA
Perfluoroheptanoic acid	PFHpA
Perfluorohexanesulfonic acid	PFHxS
Perfluorohexanoic acid	PFHxA
Perfluorononanoic acid	PFNA
Perfluorooctane sulfonate	PFOS
Perfluorooctanoic acid	PFOA
Perfluoropentanoic acid	PFPeA

Chemical Name	Chemical Abbreviation
Perfluorotetradecanoic acid	PFTA
Perfluorotridecanoic acid	PFTrDA
Perfluoroundecanoic acid	PFUnA

Additionally, the following general chemistry and physical characteristic analyses were completed for select soil samples in accordance with Worksheet #18 of the QAPP Addendum (Arcadis 2019b) by the analytical method noted:

- Total Organic Carbon by Solid Waste Test Method 846 9060A
- Grain size analysis by American Society for Testing and Materials D422-63
- pH by Solid Waste Test Method 846 9045D

These data were collected as they may be useful in future fate and transport studies.

4.5.2 Data Validation

All analytical data generated during the SI were verified and validated in accordance with the data verification procedures described in Worksheets #34 through #36 of the PQAPP (Arcadis 2019b). Each laboratory data package/sample delivery group underwent Stage 3 data validation in accordance with DoD QSM 5.1.1 (DoD 2018). Additionally, 10% of the data underwent Stage 4 data validation. Copies of the data validation reports for each sample delivery group are included as attachments to the DUSR in **Appendix K**.

4.5.3 Data Usability Assessment and Summary

A data usability assessment was completed for all analytical data associated with pre-SI and SI sampling at PICA. Documentation generated during the data usability assessments, which were compiled into a DUSR (**Appendix K**), was prepared in accordance with the USACE Engineer Manual 200-1-10 (USACE 2005), the Final DoD General Data Validation Guidelines (DoD 2019) and the Final DoD Data Validation Procedure for Per-and Polyfluoroalkyl Substances Analysis by QSM Table B-15 (DoD 2020), that reviewed precision, accuracy, completeness, representativeness, comparability, and sensitivity. A statement of overall data usability is included in the DUSR. The pre-SI and SI were limited in scope to presence or absence of PFAS, and limited sampling to areas of AFFF use or areas that may have received PFAS-contaminated material, and off-site downgradient private wells. Therefore, the 5-step DQO process described in Worksheet #37 of the PQAPP (Arcadis 2019b) was not appropriate and was not performed.

Based on the final data usability assessment, the majority of the environmental data collected at PICA during the SI were found to be acceptable and usable for this SI evaluation with the qualifications documented in the DUSR and the associated data validation reports (**Appendix K**), and as indicated in the full analytical tables (**Appendix L**) provided for the pre-SI and SI results. The only compounds qualified as rejected were perfluorotetradecanoic acid in one surface water sample and N-ethyl perfluorooctane sulfonamidoacetic acid and N-methylperfluoroocatane sulfonamidoacetic acid in one soil

sample. The remaining data are of sufficient quality to meet the objectives and requirements of the PQAPP (Arcadis 2019b) and PICA QAPP Addendum (Arcadis 2019d). Data qualifiers applied to laboratory analytical results for samples collected during the pre-SI and SI at PICA are provided in the data tables, data validation reports, and the Data Usability Summary Table located at the end of DUSR. Qualifiers for data shown on figures are defined in the notes of figures.

4.6 Project Screening Levels

The laboratory LOD is defined as "the lowest concentration for reliable reporting of a non-detect of a specific analyte in a specific matrix with a specific method at 99 percent confidence" (DoD 2017). The laboratory analyte-, sample-, and batch-specific LODs are used as the project screening levels (PSLs) to evaluate the presence or absence of the PFAS constituents analyzed for during the per-SI and SI. Since the PSLs are equivalent to the LODs, PSLs vary slightly depending on the sample- and batch-specific LODs reported by the laboratory for each analyte. For the pre-SI and SI, the presence/absence of PFAS constituents was evaluated as follows:

- If PFAS are not detected at concentrations greater than the PSLs, PFAS are not present and the release of PFAS to the sampled media is unlikely.
- If PFAS are detected at concentrations greater than the PSLs, PFAS are present, and the release of PFAS to the sampled media is likely.

The lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias is known as the limit of quantitation (LOQ; DoD 2017). Concentrations detected between the LOD and LOQ, therefore, are considered estimates and are qualified as such on laboratory analytical reports. Instrument-specific detection limits (e.g., the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration with 99 percent confidence; DoD 2017), as provided for each analyte by the laboratory, are reported along with the LODs and LOQs in the laboratory analytical reports included in the DUSR (**Appendix K**).

While PSLs (i.e., the LODs) are used to identify presence or absence of PFAS at the AOPIs sampled during the SI, the analytical data are compared to 2019 OSD risk screening levels (**Appendix A**) to make recommendations for future investigations as described in **Section 7**.

4.7 2019 Office of the Secretary of Defense Risk Screening Levels

On 15 October 2019, the OSD provided guidance on the investigation of PFOS, PFOA, and PFBS at Operation and Maintenance accounts for the National Guard-funded, Environmental Restoration Account-funded, and Base Realignment and Closure Account-funded sites (OSD 2019; **Appendix A**). The DoD guidance provides risk screening levels for PFOS, PFOA, and PFBS in groundwater (tap water) and soil, calculated using the USEPA's RSL calculator for residential and industrial/commercial worker receptor scenarios as shown in **Table 4-3**.

Chemical	Residential Scenario Screening Levels Calculated Using USEPA RSL Calculator		Industrial/Commercial Scenario Screening Levels Calculated Using USEPA RSL Calculator
	Tap Water (ng/L or ppt) [1,2]	Soil (mg/kg or ppm) [1,2,3]	Soil (mg/kg or ppm) [1,2,3]
	HQ= 0.1	HQ= 0.1	HQ= 0.1
PFOS	40	0.13	1.3
PFOA	40	0.13	1.3
PFBS	600	1.9	19

Notes:

1. Office of the Secretary of Defense. 2019. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. October 15.
2. All soil data will be screened against both the Residential Scenario and Industrial/Commercial risk screening levels, regardless of the current and projected land use of the AOPI.
mg/kg = milligram per kilogram
ng/L = nanograms per liter
ppm = parts per million
ppt = parts per trillion

The OSD residential tap water risk screening levels will be used to compare all groundwater and potable-use surface water for this Army PFAS PA/SI program. The AOPIs and other sampling locations at PICA were evaluated for the residential tap water scenario (**Table 4-3**) and the residential worker receptor scenarios for soil (**Table 4-4**, **Table 4-5**) and compared to the relevant values based on current and/or reasonably anticipated future land uses. The risk screening level based on a noncancer HQ of 0.1 was used. The data from the SI sampling and Pre-SI events were compared to the relevant risk screening levels in **Section 5**. If concentrations of PFOS, PFOA, or PFBS are detected greater than the applicable OSD risk screening levels, further investigation through a remedial investigation (RI) is recommended in **Section 7**.

5 SUMMARY AND DISCUSSION OF PRE-SI AND SI RESULTS

This section summarizes the analytical results obtained from samples collected during the pre-SI and SI at PICA (field duplicate results are provided in the associated tables). Sampled media and QA/QC samples were analyzed for the constituents prescribed per Worksheet #18 of the QAPP Addenda (Arcadis 2018b; Arcadis 2019d) and as noted in **Table 4-2**. The sample results discussion below focuses on the PFOS, PFOA, and PFBS analytical results due to these constituents' relevance to the OSD risk screening levels. The Army will make subsequent investigation decisions based on these constituents' concentrations relative to the screening criteria described above.

Tables 5-1 through **5-4** provide a summary of the groundwater, surface water, soil, and potable drinking water analytical results for PFOS, PFOA, and PFBS only. **Appendix L** includes the full suite of analytical results for these media, as well as for the QA/QC samples. **Figures 3-2** through **3-11** and **5-1** through **5-4** show the PFOS, PFOA, and PFBS analytical results in groundwater, soil, surface water, and potable drinking water. Non-detected results are reported as less than the LOQ. PFAS concentrations detected between the LOD and LOQ are estimated, as indicated with a J laboratory qualifier, and will be interpreted as presence. Detected concentrations of PFAS greater than the LODs (i.e., PFAS are present) are bolded in summary tables and on figures for the sampled media in accordance with the methodology described in **Section 4.5**.

Detections of PFOS, PFOA, and/or PFBS greater than the OSD risk screening levels are highlighted in summary tables and on figures. The risk screening levels for PFOS, PFOA, and PFBS are specific to the current and expected future land use scenario for each AOPI (**Table 4-3**, **Table 4-4**, and **Table 4-5**) (OSD 2019). As described in **Section 4.6**, multiple PFAS are present in each media; therefore, analytical results for samples collected at PICA are compared to the residential OSD screening levels. Final qualifiers applied to the data by the laboratory and the project chemist are presented on the analytical tables. Groundwater and surface water data collected during the pre-SI and SI are reported in ng/L, or parts per trillion, and soil data are reported in mg/kg, or parts per million.

Field parameters measured for groundwater during low-flow purging and sample collection and for surface water during sample collection are provided on the field forms in **Appendix H**. Soil lithological descriptions are provided on the field forms in **Appendix H**. The results of the SI are grouped by AOPI and discussed for each medium as applicable. Across PICA, groundwater was generally first encountered within a wide range of depths between 2 and 63 feet bgs.

5.1 AOPI Results

The subsections below summarize groundwater, soil, and surface water PFOS, PFOA, and PFBS analytical results associated with the AOPIs.

5.1.1 Building 169 – Firehouse 1

One groundwater sample was collected from existing MW 104-MW2 during the pre-SI sampling activities. PFOS, PFOA, and PFBS were detected at concentrations of 46 ng/L, 21 ng/L, and 14 ng/L, respectively.

This sample exceeded the OSD residential scenario screening level (RSSL) for PFOS. Refer to **Table 5-1** and **Figure 3-2**.

5.1.2 Building 3316/3321 – Firehouse 2

The subsections below summarize the soil and groundwater PFOS, PFOA, and PFBS analytical results associated with Building 3316/3321 – Firehouse 2. Refer to **Tables 5-1 and 5-3** and **Figure 3-3**.

5.1.2.1 Soil

Two soil samples were collected at two depths from one boring location. The shallow sample was collected from 0 to 0.5-foot bgs and the deeper sample was collected from 9 to 9.5-feet bgs. PFOS and PFOA were detected at maximum concentrations of 0.2 mg/kg and 0.0013 mg/kg, respectively. There were no detections of PFBS at either depth at concentrations greater than the LOQ. PFOS exceeded the OSD RSSL in both soil samples.

5.1.2.2 Groundwater

Groundwater samples were collected at two locations during the SI; existing MW 3316-3 and temporary well TW-3. PFOS, PFOA, and PFBS were detected at maximum concentrations of 50,000 ng/L, 1,000 ng/L, and 1,300 ng/L, respectively. PFOS and PFOA exceeded the OSD RSSL in both samples. There were no detections of PFBS in either well at concentrations greater than the OSD RSSL.

5.1.3 Former Pyrotechnic Area and Sanitary Landfill

Groundwater samples were collected from existing MWs 20/24-MW18, 20/24MW3, and 20/24-MW8 during the pre-SI sampling activities. PFOS and PFOA were detected at maximum concentrations of 7.4 ng/L and 70 ng/L, respectively. PFBS was not detected in any sample. One sample exceeded the OSD RSSL for PFOA. Refer to **Table 5-1** and **Figure 3-4**.

5.1.4 Former Lower Burning Grounds

The subsections below summarize the groundwater and surface water PFOS, PFOA, and PFBS analytical results associated with Former Lower Burning Grounds. Sampling was conducted during both the pre-SI and SI. Refer to **Tables 5-1 and 5-2** and **Figure 3-5**.

5.1.4.1 Groundwater

Three existing monitoring wells (1179-1, 1179A-1, and 1179A-2) were sampled during the pre-SI and two existing monitoring wells (1179-4B and 1179-7) were sampled during the SI. PFOA was detected at a maximum concentration of 26 ng/L, which is less than the OSD RSSL. PFOS and PFBS were not detected in any groundwater samples.

5.1.4.2 Surface Water

Surface water samples were collected at two locations, SW-1 and SW-2, during SI sampling activities. Both samples were collected from GPB; SW-1 was located upstream, and SW-2 was located downstream of the AOPI. PFOS, PFOA, and PFBS were detected at maximum concentrations of 72 ng/L, 9.5 ng/L, and 7.6 ng/L, respectively. PFOS exceeded the OSD RSSL for tap water in both samples.

5.1.5 Area 1222 - Gorge

The subsections below summarize the soil, groundwater, and surface water PFOS, PFOA, and PFBS analytical results associated with Area 1222 - Gorge. Refer to **Tables 5-1, 5-2, and 5-3** and **Figure 3-6.**

5.1.5.1 Soil

One soil sample was collected from 0 to 0.5-foot bgs. PFOS was detected at a concentration of 0.0018 mg/kg; PFOA and PFBS were not detected. There were no exceedances of the ORD RSSL in the soil sample.

5.1.5.2 Ground Water

Groundwater samples were collected from three locations during the SI; existing MWs OD-3A, OD-5A, and OD-6A. PFOS, PFOA, and PFBS were detected at maximum concentrations of 83 ng/L, 7.3 ng/L, and 15 ng/L, respectively. PFOS exceeded the OSD RSSL in one sample. There were no detections of PFOA or PFBS in the wells at concentrations greater than the OSD RSSL.

5.1.5.3 Surface Water

Surface water samples were collected at two locations, SW-7 and SW-8, during SI sampling activities. Both samples were collected from GPB; SW-7 was located upstream, and SW-8 was located downstream of the AOPI. There were no detections of PFOS, PFOA, or PFBS in SW-7. PFOS, PFOA, and PFBS were detected at concentrations of 12 ng/L, 2.7 ng/L, and 2.1 ng/L, respectively, in SW-8. None of the detections in SW-8 exceeded the OSD RSSLs for tap water.

5.1.6 The Lawn to the North of Building 3409/3410

The subsections below summarize the soil, ground water, and surface water PFOS, PFOA, and PFBS analytical results associated with The Lawn to the North of Building 3409/3410. Refer to **Tables 5-1, 5-2, and 5-3** and **Figure 3-7.**

5.1.6.1 Soil

Two soil samples were collected at two depths from one boring location. The shallow sample was collected from 0 to 0.5-foot bgs and the deeper sample was collected from 7 to 7.5-feet bgs. PFOS was detected at a concentration of 0.0064 mg/kg in the shallow sample; it was not detected in the deeper sample. PFOA and PFBS were not detected in either sample. There were no exceedances of the OSD RSSL in the soil samples.

5.1.6.2 Ground Water

Groundwater samples were collected at two locations during the SI; temporary well points TW-4 and TW-5. PFOS, PFOA, and PFBS were detected at maximum concentrations of 200 ng/L, 47 ng/L, and 80 ng/L, respectively. PFOS and PFOA exceeded the OSD RSSL in one well. There were no detections of PFBS in the wells at concentrations greater than the OSD RSSL.

5.1.6.3 Surface Water

One surface water sample, SW-5, was collected from an unnamed stream during SI sampling activities. PFOS, PFOA, and PFBS were detected at concentrations of 4,100 ng/L, 78 ng/L, and 230 ng/L, respectively. PFOS and PFOA exceeded the OSD RSSLs for tap water.

5.1.7 Former Building 24

Two groundwater samples were collected from existing MWs 9-A and 9-C during the pre-SI sampling activities. PFOS, PFOA, and PFBS were detected at maximum concentrations of 50 ng/L, 13 ng/L, and 5.8 ng/L, respectively. PFOS was detected in MW 9-C at a concentration that exceeded the OSD RSSL. PFOA and PFBS were not detected at concentrations that exceeded the OSD RSSL. Refer to **Table 5-1** and **Figure 3-8**.

5.1.8 Post Farm Landfill

Three groundwater samples were collected from two existing MWs, 23MW-1 and 23MW-2, as well as one temporary well point, TW-2. PFOS and PFOA were detected at maximum concentrations of 3.6 ng/L and 4.6 ng/L, respectively. PFBS was not detected. None of the detections exceeded the OSD RSSLs. Refer to **Table 5-1** and **Figure 3-9**.

5.1.9 Former WWTP Facility

The subsections below summarize the soil, ground water, and surface water PFOS, PFOA, and PFBS analytical results associated with the Former WWTP Facility. Refer to **Tables 5-1, 5-2 and 5-3** and **Figure 3-10.**

5.1.9.1 Soil

One soil sample was collected from 0 to 0.5-foot bgs. PFOS and PFOA were detected at concentrations of 0.0093 mg/kg and 0.0097 mg/kg, respectively; PFBS was not detected. There were no exceedances of the OSD RSSL in the soil sample.

5.1.9.2 Ground Water

Groundwater samples were collected during pre-SI and SI sampling activities. Two existing monitoring wells, 38MW-1 and MW70-1A, were sampled during the pre-SI and three existing monitoring wells, 80-1, 80-3, and MW-12E, were sampled during the SI. PFOS, PFOA, and PFBS were detected at maximum

concentrations of 6.8 ng/L, 12 ng/L, and 2.9 ng/L, respectively. None of the detections exceeded the OSD RSSLs.

5.1.9.3 Surface Water

Surface water samples were collected at two locations, SW-3, which was collected from GPB, and SW-4, which was collected from a tributary to GPB. PFOS, PFOA, and PFBS were detected at maximum concentrations of 56 ng/L, 9.4 ng/L, and 7.41 ng/L, respectively. PFOS in SW-3 exceeded the OSD RSSL for tap water. None of the detections for PFOA and PFBS exceeded the OSD RSSLs for tap water.

5.1.10 Building 3801 – NJARNG Helipad Area

The subsections below summarize the soil, ground water, and surface water PFOS, PFOA, and PFBS analytical results associated with Building 3801 – NJARNG Helipad Area. Refer to **Tables 5-1, 5-2, and 5-3 and Figure 3-11.**

5.1.10.1 Soil

Two soil samples were collected at two depths from one boring location. The shallow sample was collected from 0 to 0.5-foot bgs and the deeper sample was collected from 9.5 to 10-feet bgs. PFOS was detected at a concentration of 0.0008 mg/kg in the shallow sample; it was not detected in the deeper sample. PFOA and PFBS were not detected in either sample. There were no exceedances of the OSD RSSL in the soil samples.

5.1.10.2 Ground Water

Groundwater samples were collected from two existing monitoring wells, 175MW-1 and 175MW-2 during the SI. PFOS, PFOA, and PFBS were detected at maximum concentrations of 32 ng/L, 12 ng/L, and 5.3 ng/L, respectively. There were no detections of PFOS, PFOA, and PFBS in the wells at concentrations greater than the OSD RSSL.

5.1.10.3 Surface Water

One surface water sample, SW-6, was collected from a tributary to the Hibernia Brook during SI sampling activities. PFOS, PFOA, and PFBS were detected at concentrations of 160 ng/L, 11 ng/L, and 4.1 ng/L, respectively. There were no detections of PFOS, PFOA, and PFBS at concentrations greater than the OSD RSSL. PFOS exceeded the OSD RSSLs for tap water. PFOA and PFBS were not detected at concentrations that exceeded the OSD RSSLs for tap water.

5.2 Other Areas Sampled

These sections summarize the data for areas not associated with an AOPI.

5.2.1 Eastern Boundary On-Site

The subsections below summarize the groundwater and surface water PFOS, PFOA, and PFBS analytical results associated with the eastern boundary sampling. As discussed in **Section 2.7**, groundwater near Lake Denmark flows from east to west (i.e., onto PICA). Groundwater south of Lake Denmark, near Snake Hill Road, flows west to east (i.e., off of PICA). Therefore, eastern boundary sampling conducted near Lake Demark was completed to collect samples that are representative of groundwater entering PICA from the east to determine if off-post, upgradient PFAS sources may be present in the vicinity of PICA (referred to as samples representative of groundwater from the east). The eastern boundary sampling conducted south of Lake Denmark was completed to collect samples that are representative of groundwater downgradient of two AOPIs that may be migrating off of PICA (referred to as samples downgradient of AOPIs). Refer to **Tables 5-1 and 5-2** and **Figure 5-1**.

- Samples Representative of Groundwater from the East - These include groundwater samples collected from MWs RTI-MW-26S through 29S, as well as surface water samples, SW-9 and SW-10, which were collected from a tributary to the Hibernia Brook and a tributary to Burnt Meadow Brook, respectively.
- Samples Downgradient of AOPIs – These include a surface water sample SW-12, collected from a tributary to the Hibernia Brook[8], as well as two groundwater samples, one from approximately 5 feet bgs and one from approximately 45 feet bgs, collected from temporary well point TW-9.

5.2.1.1 Ground Water

- Samples Representative of Groundwater from the East - PFOS and PFOA were detected at maximum concentrations of 5.6 ng/L and 120 ng/L, respectively. PFBS was not detected. PFOA was detected in one well at a concentration that exceeded the OSD RSSL. PFOS and PFBS did not exceed the OSD RSSLs.
- Samples Downgradient of AOPIs - PFOS, PFOA, and PFBS were detected at maximum concentrations of 42 ng/L, 7.9 ng/L, and 7.5 ng/L, respectively. PFOS was detected in one well at a concentration that exceeded the OSD RSSL. PFOA and PFBS did not exceed the OSD RSSLs.

5.2.1.2 Surface Water

- Samples Representative of Groundwater from the East - PFOS, PFOA, and PFBS were detected at maximum concentrations of 1.7 ng/L, 7.8, ng/L, and 1.1 ng/L, respectively. PFOS, PFOA, and PFBS did not exceed the OSD RSSLs for tap water.
- Sample Downgradient of AOPIs - PFOS, PFOA, and PFBS were detected at concentrations of 79 ng/L, 5.1 ng/L, and 9.9 ng/L, respectively. PFOS was detected at a concentration that exceeded the OSD RSSL for tap water. PFOA and PFBS did not exceed the OSD RSSLs for tap water.

[8] SW-9 and SW-12 were collected from different tributaries to the Hibernia Brook.

5.2.2 Southern Boundary On-Site

The subsections below summarize the ground water and surface water PFOS, PFOA, and PFBS analytical results associated with Southern Boundary On-Site. While not directly associated with any particular AOPI, Southern Boundary On-Site is situated near the southern boundary of PICA, downgradient of the majority of the AOPIs. These samples were collected to determine the potential for PFAS to migrate off PICA toward nearby downgradient private potable wells. Refer to **Tables 5-1 and 5-2** and **Figure 5-2.**

5.2.2.1 Ground Water

Groundwater samples were collected during pre-SI sampling activities. Thirteen existing monitoring wells, SB1-1, SB1-2, SB1-3, SB2-1A, SB2-2, SB2-3, SB3-1B, SB3-2, SB3-3, SB4-1, SB4-2, SB4-3, and SB4-4, were sampled. PFOS, PFOA, and PFBS were detected at maximum concentrations of 300 ng/L, 18 ng/L, and 6.7 ng/L, respectively. PFOS was detected in three wells at concentrations that exceeded the OSD RSSL. PFOA and PFBS did not exceed the OSD RSSLs.

5.2.2.2 Surface Water

One surface water sample, GPB-1, was collected from GPB during the pre-SI sampling activities. PFOS, PFOA, and PFBS were detected at concentrations of 130 ng/L, 13 ng/L, and 9.1 ng/L, respectively. PFOS was detected at a concentration that exceeded the OSD RSSL. PFOA and PFBS did not exceed the OSD RSSLs.

5.2.3 Northern Boundary On-Site

While not directly associated with any particular AOPI, the Northern Boundary is located upstream of all the AOPIs on PICA. One surface water sample was collected from a tributary to GPB. PFOA was detected at a concentration of 2.0 ng/L, which does not exceed the OSD RSSL for tap water. PFOS and PFBS were not detected. Refer to **Table 5-2** and **Figure 5-3**.

5.2.4 Mid-Valley Upgradient On-Site

While not directly associated with any particular AOPI, Mid-Valley Upgradient On-Site is centrally located within PICA, upgradient of the southern AOPIs. One groundwater sample was collected from existing monitoring well, 171MW-12. PFOS, PFOA, and PFBS were not detected in the groundwater sample. Refer to **Table 5-1** and **Figure 5-4.**

5.3 Off-Post Potable Drinking Water

Groundwater samples were collected from seven potable off-post private wells during the pre-SI. Four samples were collected from one private well (0.58 A[9]) and one sample each were collected from six additional private wells (0.01 A, 0.94 A, 0.95 A, 0.97 A, 0.98 A, and 0.98 B). Private well 0.58 A was

[9] The private wells are not listed by address but were given designations that indicate the distance, in miles, from the PICA boundary.

sampled during two separate sampling events to determine if the original results could be reproduced. The original sample was collected directly from a spout in the basement. During the second sampling event, the samples were collected from two separate bathroom sinks and a kitchen sink. Refer to **Table 5-4** and **Figure 5-5**.

- 0.58 A - PFOS, PFOA, and PFBS were detected at maximum concentrations of 25 ng/L, 14 ng/L, and 5.2 ng/L, respectively.
- 0.95 A – PFOS and PFOA were detected at concentrations of 0.89 ng/L and 1.2 ng/L, respectively; PFBS was not detected.
- 0.97 A – PFOS and PFOA were detected at concentrations of 2.3 ng/L and 2.6 ng/L, respectively; PFBS was not detected.
- 0.98B – PFOS and PFOA were detected at concentrations of 0.92 ng/L and 1.0 ng/L, respectively; PFBS was not detected.
- 0.01 A, 0.94 A, and 0.98 A – PFOS, PFOA, and PFBS were not detected.

PFOS, PFOA, and PFBS were not detected at concentrations that exceeded the OSD RSSL.

5.4 QA/QC Samples

The full analytical results for QA/QC samples collected during the SI are included in **Appendix L**. PFAS were not detected greater than LODs in any of the QA/QC samples collected during the pre-SI or SI sampling.

5.5 Conceptual Site Models

The preliminary CSMs presented in the PA Report (Arcadis 2019c) were re-evaluated and updated, if necessary, based on the SI sampling results. The CSMs presented on **Figures 5-6** through **5-14** and in this section therefore represent the current understanding of the potential for human exposure. For some AOPIs, the CSM is the same and thus shown on the same figure.

Based on the historical use of AFFF and chromium plating operations at the AOPIs, affected media are likely to consist of soil, groundwater, surface water, and sediment. Release and transport mechanisms include dissolution/desorption from soil to groundwater, transport via sediment carried in and dissolution to stormwater and surface water, discharge/recharge between groundwater and surface water, and adsorption/desorption between surface water and sediment. Generic categories of potential human receptors and their associated exposure scenarios that are typically evaluated in a CERCLA human health risk assessment were considered and include on-installation site workers (e.g., industrial/commercial workers, utility workers, or future construction workers who could be exposed to chemicals in soil at an AOPI or to chemicals in tap water in an industrial/commercial building), on-installation residents (e.g., adults and children who could be exposed to chemicals in tap water in a residence), and on-installation recreational users (e.g., hikers or hunters who could be exposed to chemicals in waterways at an installation). Off-installation receptor types could include drinking water receptors (i.e., commercial/industrial workers or residents) and recreational users.

Human exposure pathways are shown as “complete, “potentially complete”, or “incomplete” on the CSM figures. A complete exposure pathway consists of a constituent source and release mechanism, a transport or retention medium, an exposure point where human contact with the contaminated medium could occur, and an exposure route at the exposure point. If any of these elements is missing, the exposure pathway is incomplete. Pathways are “potentially complete” where data are insufficient to conclude the pathway is either “complete” or “incomplete”. References in this section to PFAS detected or not detected in sampled environmental media are specific to PFOS, PFOA, and/or PFBS as these have established screening levels per the 2019 OSD memo (OSD 2019).

CSMs were developed for each individual AOPI and were combined where source media, potential migration pathways and exposure media, and human exposure pathway determinations are congruent.

The following exposure pathway determinations apply to all CSMs:

- The AOPIs are not residential or recreational sites and are wholly located within the installation boundaries. Therefore, the soil exposure pathways for on-installation residents and recreational users and for off-installation receptors are incomplete.
- Recreational users are not likely to contact groundwater during outdoor recreational activities. Therefore, the groundwater exposure pathway for on-installation recreational users is incomplete.
- PFAS were detected in groundwater at or downgradient of all AOPIs. Groundwater originating at the AOPIs flows off-post through the installation’s southern and eastern boundaries. Due to the absence of LUCs preventing potable use of groundwater in these areas, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for off-installation receptors is potentially complete.
- Surface water bodies on-post are not used for drinking water; therefore, the surface water exposure pathway for on-installation drinking water receptors is incomplete. On-installation site workers and residents are not likely to otherwise contact surface water and sediment in the on-post surface water bodies; therefore, these exposure pathways are also incomplete. Recreational users could contact constituents in on-post receiving surface water bodies through incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for on-installation recreational users are potentially complete for all AOPIs except Post Farm Landfill.
- Surface water bodies flow off-post through the installation’s southern boundary via GPB and through the installation’s eastern boundary via Ames Brook and the Hibernia Brook tributary. These surface water bodies are not used as a source of drinking water within 5 miles of the installation. Therefore, the surface water exposure pathway is incomplete for off-installation drinking water receptors. However, recreational users off-post could contact constituents in off-post surface water bodies through incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for off-installation recreational users are potentially complete.

Additional exposure pathway descriptions for each CSM are listed below by figure.

Figure 5-6 shows the CSM for AOPI Building 169 – Firehouse 1. AFFF was historically released to soil and/or paved surfaces at this AOPI due to AFFF use related to firehouse operations such as nozzle testing and hose cleanouts.

- Soil samples were not collected for PFAS analysis at this AOPI. Site workers could contact constituents in soil via incidental ingestion, dermal contact and inhalation of dust; therefore, the soil exposure pathway for on-installation site workers is potentially complete.

- This AOPI is upgradient of or in the vicinity of drinking water wells used to supply potable water at PICA. Therefore, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for on-installation site workers and residents are potentially complete.

Figure 5-7 shows the CSM for AOPI Building 3316 – Firehouse 2. AFFF was historically released to soil and/or paved surfaces at this AOPI due to AFFF use related to firehouse operations.

- Site workers could contact constituents in soil via incidental ingestion, dermal contact and inhalation of dust and PFAS has been detected in soil; therefore, the soil exposure pathway for on-installation site workers is complete.
- This AOPI is downgradient of and not likely to affect existing drinking water wells used to supply potable water at PICA. However, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for on-installation site workers and residents are potentially complete to account for potential future use of the downgradient on-post groundwater.

Figure 5-8 shows the CSM for AOPIs Former Pyrotechnic Area and Sanitary Landfill and Former Lower Burning Grounds. AFFF was historically released to soil, surface water, and sediment at these AOPIs to extinguish fires.

- Soil samples were not collected for PFAS analysis at this AOPI. Site workers could contact constituents in soil via incidental ingestion, dermal contact and inhalation of dust; therefore, the soil exposure pathway for on-installation site workers is potentially complete.
- These AOPIs are downgradient of and not likely to affect existing drinking water wells used to supply potable water at PICA. However, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for on-installation site workers and residents are potentially complete to account for potential future use of the downgradient on-post groundwater.

Figure 5-9 shows the CSM for AOPI Area 1222 – Gorge. AFFF was historically released to soil, surface water, and sediment at this AOPI due to AFFF use related to fire responses.

- Site workers could contact constituents in soil via incidental ingestion, dermal contact and inhalation of dust and PFAS was detected in the soil; therefore, the soil exposure pathway for on-installation site workers is complete.
- This AOPI is upgradient of or in the vicinity of drinking water wells used to supply potable water at PICA. Therefore, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for on-installation site workers and residents are potentially complete.

Figure 5-10 shows the CSM for AOPI Lawn to the North of Building 3409/3410. AFFF was historically released to soil at this AOPI due to AFFF training activities such as arc training and nozzle testing.

- Site workers could contact constituents in soil via incidental ingestion, dermal contact and inhalation of dust and PFAS was detected in soil; therefore, the soil exposure pathway for on-installation site workers is complete.
- This AOPI is downgradient of and not likely to affect existing drinking water wells used to supply potable water at PICA. However, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for on-installation site workers and residents are potentially complete to account for potential future use of the downgradient on-post groundwater.

Figure 5-11 shows the CSM for AOPI Former Building 24. AFFF was historically released to subsurface soil, surface water, and sediment at this AOPI due to AFFF use related to chromium plating.

- Soil samples were not collected for PFAS analysis at this AOPI. Site workers (e.g., future construction workers) could contact constituents in subsurface soil via incidental ingestion, dermal contact and inhalation of dust; therefore, the soil exposure pathway for on-installation site workers is potentially complete.
- This AOPI is upgradient of or in the vicinity of drinking water wells used to supply potable water at PICA. Therefore, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for on-installation site workers and residents are potentially complete.

Figure 5-12 shows the CSM for AOPI Post Farm Landfill. It was indicated that buried drums containing chromium plating related wastes from Former Building 24 could have been located at the Post Farm Landfill.

- During a removal action conducted at the landfill in 1993, 390 drums and 38 cubic yards of soil were removed. LUCs were also put in place for soil. Therefore, , the soil exposure pathway for on-installation site workers is incomplete.
- This AOPI is downgradient of and not likely to affect existing drinking water wells used to supply potable water at PICA. However, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for on-installation site workers and residents are potentially complete to account for potential future use of the downgradient on-post groundwater.

Figure 5-13 shows the CSM for AOPI Former WWTP Facility. AFFF was historically released to soil (former sludge beds and leach fields) at this AOPI due to potential AFFF rinse reaching the WWTP via the sanitary sewer system.

- Site workers could contact constituents in soil via incidental ingestion, dermal contact and inhalation of dust and PFAS was detected in soil; therefore, the soil exposure pathway for on-installation site workers is complete.
- This AOPI is downgradient of and not likely to affect existing drinking water wells used to supply potable water at PICA. However, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for on-installation site workers and residents are potentially complete to account for potential future use of the downgradient on-post groundwater.

Figure 5-14 shows the CSM for AOPI Building 3801 – NJARNG Helipad Area. AFFF was historically released to soil and/or paved surfaces at this AOPI due to a fire response.

- Site workers could contact constituents in soil via incidental ingestion, dermal contact and inhalation of dust and PFAS was detected in soil; therefore, the soil exposure pathway for on-installation site workers is complete.
- This AOPI is downgradient of and not likely to affect existing drinking water wells used to supply potable water at PICA. However, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for on-installation site workers and residents are potentially complete to account for potential future use of the downgradient on-post groundwater.

6 DATA LIMITATIONS AT PICA

Data limitations associated with the PA are listed in Section 5.2 of the PA Report (Arcadis 2019c). The data limitations relevant to the development of this SI for PFAS at PICA are discussed below.

The searches for ecological receptors and off-post PFAS sources were not exhaustive and were limited to easily identifiable and readily available information evaluated during the relevant documents research, installation personnel interviews, and site reconnaissance.

The CSMs considered potential exposures of on-installation receptors to PFAS in groundwater based on the proximity of AOPIs to existing, operational wells used to supply drinking water at PICA. The potential for new potable well installations is improbable considering the Army implements controls which prevent intrusive work without directorate of public works approval per the installation's master plan and the dig permitting process. However, these Army controls do not prevent future consumption of drinking water for land if it is no longer controlled by the Army. Additionally, the CSMs do not include ecological receptors and exposure pathways. The potential for ecological exposures to PFAS may be evaluated at a future date if those pathways warrant further consideration.

Finally, the available PFAS analytical data are limited to the historical data presented in **Appendix E** (collected from on-post potable wells by American Water and USEPA in 2016) and the data presented in **Appendix L** (collected during the pre-SI and SI). The limited sampling scope of the SI focused in identifying presence or absence of PFAS in certain media at the AOPIs. SI sampling at locations at or in close proximity of the AOPIs and potable water wells did not delineate the extent of PFAS impacts or fully identify the primary migration pathways for the chemicals. For those AOPIs that warrant further investigation based on the information included within this SI report, a more comprehensive PFAS evaluation may be conducted during a future investigation (i.e., remedial investigation).

7 CONCLUSIONS AND RECOMMENDATIONS

The objective of this SI was to evaluate potential PFAS releases at PICA. The Army's PFAS SI program has focused on identifying the locations of potential releases through the storage, disposal, or use of PFAS containing materials per the Army Guidance for Addressing Releases of Per-and Polyfluoroalkyl Substances (Army 2018).

Although there is currently no federal maximum contaminant level defined for any PFAS, OSD provided residential risk screening levels for PFOS, PFOA and PFBS in soil and groundwater (tap water) and industrial/commercial risk screening levels for PFOS, PFOS and PFBS in soil (**Appendix A**).

Results from the PA at PICA identified AOPIs that necessitated continuing onto the SI phase in accordance with CERCLA. Because private potable wells were known to be potentially located downgradient of PICA, and PFAS were detected in the on-site drinking water wells at concentrations greater than the USEPA's LHA of 70 ng/L and the OSD risk screening levels, a pre-SI investigation was conducted at PICA beginning in September 2018. The purpose of the pre-SI was to evaluate the potential for PFAS to be migrating off-post on the Southern Boundary of PICA and collect sufficient data to accelerate the collection of groundwater samples from off-post private potable wells.

SI sampling was also subsequently completed at PICA at seven AOPIs, as well as the eastern boundary and two upgradient areas on PICA. The samples collected from the AOPIs and in areas peripheral to the AOPI source areas were collected to determine presence or absence of PFAS at each of these AOPIs.

The following locations were sampled during the pre-SI and SI. These scopes of work were completed in accordance with the Final PQAPPs (Arcadis 2018c; Arcadis 2019d) and the PICA QAPP Addenda (Arcadis 2018b; Arcadis 2019c).

- AOPIs - All AOPIs were sampled during the pre-SI and SI at PICA to further evaluate PFAS-related releases and identify presence or absence of PFAS. Except for the Post Farm Landfill, PFAS was detected in at least one media at the remaining AOPIs at a concentration that exceeded the applicable OSD RSSL. The highest groundwater and soil concentrations were associated with the Building 3316/3321 – Firehouse 2 AOPI. The highest surface water concentrations were associated with the Lawn North of Building 3409/3410. Both PFOS and PFOA have been detected at the AOPIs at concentrations that exceed the OSD RSSLs; however, PFOS has been detected at higher concentrations than PFOA and at a higher frequency. Refer to **Table 7-1** for a summary of the data.
- PICA Boundaries – Refer to **Table 7-2** for a summary of the data
    - Groundwater and surface water samples were collected from the eastern[10] and southern boundaries to evaluate the potential for PFAS to migrate off-post. PFOS was detected in groundwater and surface water at both boundaries at concentrations that exceeded the applicable OSD RSSL.

[10] On the eastern boundary of PICA, south of Lake Denmark, near Snake Hill Road, groundwater flows from west to east, off the installation. In Section 5.2.1 these are referred to as Samples Downgradient of AOPIs.

- Groundwater and surface water samples were collected from the eastern[11] and northern boundaries and the Mid-Valley area of PICA, to determine if off-post, upgradient PFAS sources may be present. PFOA was detected in a groundwater sample collected from the eastern boundary at a concentration that exceeded the OSD RSSL; PFOS and PFBS were not detected at concentrations that exceeded the OSD RSSLs. PFOS, PFOA and PFBS were not detected at the northern and mid-Valley areas at concentrations that exceeded the OSD RSSL.
- Off-post downgradient private wells south of PICA were sampled to determine the potential for PICA to have impacted those wells. None of the sample results exceeded the OSD RSSLs.

Table 7-1. Summary of AOPI Pre-SI and SI Data

AOPI	Groundwater			Surface Water			Soil		
	Sampled?	> OSD RSSL?	Max Conc	Sampled?	>OSD RRSL?	Max Conc	Sampled?	>OSD RSSL?	Max Conc
Building 169 – Firehouse 1	Yes	Yes	PFOS - 46	No	NA	NA	No	NA	NA
Buildings 3316/3321 – Firehouse 2	Yes	Yes	PFOS – 50,000; PFOA – 1,000	No	NA	NA	Yes	Yes	PFOS – 0.2
Former Pyrotechnic Area and Sanitary Landfill	Yes	Yes	PFOA - 70	No	NA	NA	No	NA	NA
Former Lower Burning Grounds	Yes	No	NA	Yes	Yes	PFOS - 72	No	NA	NA
Area 1222 - Gorge	Yes	Yes	PFOS - 83	Yes	No	NA	Yes	No	NA
Lawn to the North of Building 3409/3410	Yes	Yes	PFOS – 200; PFOA - 47	Yes	Yes	PFOS – 4,100; PFOA - 78	Yes	No	NA

[11] On the eastern boundary of PICA, near Lake Denmark, groundwater flows from east to west, onto the installation. In section 5.2.1 these are referred to as Samples Representative of Groundwater from the East.

AOPI	Groundwater			Surface Water			Soil		
	Sampled?	> OSD RSSL?	Max Conc	Sampled?	>OSD RRSL?	Max Conc	Sampled?	>OSD RSSL?	Max Conc
Former Building 24	Yes	Yes	PFOS - 50	No	NA	NA	No	NA	NA
Post Farm Landfill	Yes	No	NA	No	NA	NA	No	NA	NA
Former WWTP Facility	Yes	No	NA	Yes	Yes	PFOS - 56	Yes	No	NA
Building 3801 – NJARNG Helipad	Yes	No	NA	Yes	Yes	PFOS - 160	Yes	No	NA

Notes:
1. Concentrations are given in ng/L for groundwater and surface water and mg/kg for soil.
2. Maximum concentrations are only given for compounds that exceed the OSD RSSL.
3. NA – not applicable

Table 7-2. Summary of Non-AOPI Pre-SI and SI Data

Location	Groundwater			Surface Water			Soil		
	Sampled?	> OSD RSSL?	Max Conc	Sampled?	>OSD RRSL?	Max Conc	Sampled?	>OSD RSSL?	Max Conc
Eastern Boundary (Samples Representative of Groundwater from the East)	Yes	Yes	PFOA - 120	Yes	No	NA	No	NA	NA
Eastern Boundary (Samples Downgradient of AOPIs)	Yes	Yes	PFOS - 42	Yes	Yes	PFOS - 79	No	NA	NA
Southern Boundary	Yes	Yes	PFOS - 300	Yes	Yes	PFOS – 130	No	NA	NA
Northern Boundary	No	NA	NA	Yes	No	NA	No	NA	NA
Mid-Valley	Yes	No	NA	No	NA	NA	No	NA	NA
Off-Post Private Wells	Yes	No	NA	No	NA	NA	No	NA	NA

Notes:
1. Concentrations are given in ng/L for groundwater and surface water and mg/kg for soil.
2. Maximum concentrations are only given for compounds that exceed the OSD RSSL.
3. NA – not applicable

During the PA, prior to the pre-SI and SI sampling, a preliminary CSM was developed for each AOPI. The preliminary CSMs identified potential human receptors and exposure pathways for groundwater and surface water that is known to be used, or could realistically be used in the future, as a source of drinking water and identified potential soil and sediment exposure pathways.

The preliminary CSMs presented in the PA Report (Arcadis 2019c) were re-evaluated based on the pre-SI and SI sampling results. The CSMs presented on **Figures 5-6** through **5-14** therefore represent the current understanding of the potential for human exposure. Potentially complete exposure pathways are summarized below:

- Soil exposure pathways for on-installation site workers were considered to be potentially complete or complete at all 10 AOPIs.
- There are three AOPIs (Area 1222 – Gorge, Former Building 24, and Building 169 – Firehouse 1) at which the groundwater exposure pathways for on-post receptors were considered to be potentially complete because the AOPIs are upgradient of or potentially impacting groundwater wells that are used to provide drinking water at PICA. At the remaining seven AOPIs, the groundwater exposure pathways for on-post receptors are potentially complete to account for potential future use of the downgradient on-post groundwater.
- Due to a lack of LUCs off-installation and downgradient of PICA, the groundwater exposure pathways for off-installation receptors were also considered to be potentially complete for all 10 AOPIs.
- Surface water is not used for drinking water at PICA; however, recreational users could contact constituents in surface water and sediment via incidental ingestion and dermal contact. Therefore, the surface water and sediment exposure pathways were considered to be potentially complete for on-post receptors for all AOPIs except Post Farm Landfill.
- Downstream of the installation and within 5 miles, surface water is used for recreation; therefore, the surface water and sediment exposure pathways were considered to be potentially complete for off-post receptors for all 10 AOPIs.

Based on the PFAS analytical data collected in September 2018, May 2019, July 2019, and from November 2019 through March 2020, in accordance with the guidance provided by the OSD in October 2019, further investigation through an RI is recommended at PICA at this time. The RI will identify the need to collect samples to determine nature and extent, as well as potential off-post sources. In accordance with CERCLA, a site-specific risk assessment will also be developed.

Table 7-3 below summarizes the sampling at PICA and rationale for recommendations for future investigations or no action at this time.

Table 7-3. Summary of PFAS Sampling at PICA and Recommendations

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels?				Recommendation	Rationale
	GW	SO	SW	SE		
Building 169 – Firehouse 1	Yes	NS	NS	NS	Future investigation	GW exceedance of OSD risk screening levels
Buildings 3316/3321 – Firehouse 2	Yes	Yes	NS	NS	Future investigation	GW and SO exceedance of OSD risk screening levels
Former Pyrotechnic Area and Sanitary Landfill	Yes	NS	NS	NS	Future investigation	GW exceedance of OSD risk screening levels
Former Lower Burning Grounds	No	NS	Yes	NS	Future investigation	SW exceedance of OSD risk screening levels
Area 1222 – Gorge	Yes	No	No	NS	Future investigation	GW exceedance of OSD risk screening levels
Lawn to the North of Building 3409/3410	Yes	No	Yes	NS	Future investigation	GW and SW exceedance of OSD risk screening levels
Former Building 24	Yes	NS	NS	NS	Future investigation	GW exceedance of OSD risk screening levels
Post Farm Landfill	No	NS	NS	NS	No action	No exceedances of OSD risk screening levels in GW
Former WWTP Facility	No	No	Yes	NS	Future investigation	SW exceedance of OSD risk screening levels
Building 3801 – New Jersey Army National Guard Helipad Area	No	No	Yes	NS	Future investigation	SW exceedance of OSD risk screening levels

8 REFERENCES

Arcadis U.S., Inc. (Arcadis). 2018a. Accident Prevention Plan: A-E Services, PFASs Contamination in the Cleanup/Restoration Programs at Active Army Installations – Nationwide. Prepared for USACE, Baltimore District. March.

Arcadis. 2018b. Uniform Federal Policy-Quality Assurance Project Plan Addendum, USAEC PFAS PA/SI, Picatinny Arsenal, New Jersey. September.

Arcadis. 2018c. Final Programmatic Uniform Federal Policy Quality Assurance Project Plan, USAEC PFAS PA/SI, Active Army Installations, Nationwide, USA. October.

Arcadis. 2019a. Amendment to Site Safety and Health Plan, Picatinny Arsenal, Preliminary Assessment / Site Investigation. September.

Arcadis. 2019b. Final Programmatic Uniform Federal Policy (UFP) Quality Assurance Project Plan (QAPP), USAEC PFAS PA/SI, Active Army Installations, Nationwide, USA. October.

Arcadis. 2019c. Preliminary Assessment of Per- and Polyfluroalkyl Substances, Revision 0, Picatinny Arsenal, NJ. February 2019.

Arcadis. 2019d. Final UFP QAPP Addendum, Revision 0, USAEC PFAS PA/SI, Picatinny Arsenal, NJ. November 2019.

Army. 2018. Army Guidance for Addressing Releases of Per- and Polyfluoroalkyl Substances. September 4. Available online at: https://www.fedcenter.gov/admin/itemattachment.cfm?attachmentid=1150.

Conestoga-Rovers & Associates (CRA). 2010. Remedial Investigation Report Operable Unit 2 Radiation Technology Inc. Superfund Site Rockway Township, New Jersey. August.

Dames & Moore. 1991. Remedial Investigation Concept Plan for Picatinny Arsenal. March.

Department of Defense (DoD). 2017. Fact Sheet: Detection and Quantitation – What Project Managers and Data Users Need to Know. October.

DoD. 2018. Quality Systems Manual, Version 5.1.1, 2018. February.

Environmental Chemical Corporation. 2020. Final Feasibility Study for On-Post Munitions Response Sites (PICA-003-R-01, PICA-003-R-02, PICA-006-R-01, and PICA-008-R-01), Picatinny Arsenal Cleanup Contract, Picatinny Arsenal, New Jersey. January 2020.

Interstate Technology Regulatory Council. 2017. History and Use of Per-and Polyfluoroalkyl Substances (PFAS). November. Available online at: https://pfas-1.itrcweb.org/wp-content/uploads/2017/11/pfas_fact_sheet_history_and_use__11_13_17.pdf.

Interstate Technology Regulatory Council. 2020. Section 3.1 Firefighting Foams. Updated April 14. Available online at: https://pfas-1.itrcweb.org/3-firefighting-foams/#3_1

IT Corporation. 2001. Picatinny Arsenal Task Order 17 Phase II Group 3 Sites Remedial Investigation Report Sites 1, 2, & 4, Volume 1. October.

Lucey, Carol S. 1972. Geology of Morris County in Brief. Bureau of Geology and Topography, Trenton, New Jersey. 1972.

NJDEP. 2005. Field Sampling Procedures Manual. August.

Office of the Secretary of Defense (OSD). 2019. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. October.

PICA. 2019. Picatinny Arsenal Army Cleanup Program, Installation Action Plan, April.

PICA 2004. Record of Decision Site 23 – The Post Farm Landfill, Picatinny, New Jersey. August.

Renova Environmental Services. 2017. Spill Prevention, Control, and Countermeasure (SPCC) Plan 2017 Update. October.

USACE. 2005. Environmental Quality: Guidance for Evaluating Performance-Based Chemical Data, Engineer Manual 200-1-10, CEMP-RA/CECW-E, June 30.

USAEC. 2020. Proposed Plan for Mortar and Skeet Area (PICA-006-R-02 and CC-057) Picatinny Arsenal, New Jersey. May 2020.

USEPA. 2014. Provisional Peer-Reviewed Toxicity Values for Perfluorobutane Sulfonate (CASRN 375-73-5) and Related Compound Potassium Perfluorobutane Sulfonate (CASRN 29420-49-3). EPA/690/R-14/012F. July 17.

USEPA. 2016a. Lifetime Health Advisories and Health Effects Support Documents for Perfluorooctanoic Acid and Perfluorooctane Sulfonate. EPA-HQ-OW-2014-0138; FRL-9946-91-OW. Federal Register/ Vol. 81. No. 101. May 25. Available online at: https://www.govinfo.gov/content/pkg/FR-2016-05-25/pdf/2016-12361.pdf.

USEPA. 2016b. Memorandum from the Office of Ground Water and Drinking Water: Clarification about the Appropriate Application of the PFOA and PFOS Drinking Water Health Advisories. November 15. Available online at: https://www.epa.gov/sites/production/files/2016-11/documents/clarification_memo_pfoapfos_dw_has.pdf.

Weston Solutions, Inc. 2014. Final Remedial Investigation Report. Military Munitions Response Program Remedial Investigation September.

TABLES

Table 4-1 - Site Inspection Sampling Location Details
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

AOPI	Matrix	Sample ID	Depth Interval (ft bgs)	Sample Method	Analytes
Building 169 – Firehouse 1	Groundwater	PTA-FH1-104-MW2-091118-N	37	low-flow	PFAS
Buildings 3316/3321 – Firehouse 2	Groundwater	PICA-FH2-3316-3-(11052019)	18	low-flow	PFAS
		PICA-FH2-TW-3-(12112019)	20	Sonic / low-flow	PFAS
	Soil	PICA-FH2-SO-03-0-0.5(12112019)	0.0-0.5	Sonic	PFAS
		PICA-FH2-SO-9.0-9.5(12112019) / PICA-FD-SO-(12112019)-1FD	9.0-9.5	Sonic	PFAS
Former Pyrotechnic Area and Sanitary Landfill	Groundwater	PTA-20/24-MW3-091118-N	10	low-flow	PFAS
		PTA-20/24-MW8-091118-N	10	low-flow	PFAS
		PTA-20/24-MW18-091118-N	15	low-flow	PFAS
Former Lower Burning Grounds	Groundwater	PTA-LBG-1179-1-091918-N	47	low-flow	PFAS
		PTA-LBG-1179A-1-091918-N / PTA-DUP-2-091918FD	17	low-flow	PFAS
		PTA-LBG-1179A-2-091918-N	14	low-flow	PFAS
		PICA-PSL-1179-4B-(11052019)	151	low-flow	PFAS
		PICA-PSL-1179-7-(11052019)	22	low-flow	PFAS
	Surface Water	PICA-PSL-SW-1-(11052019) / PICA-FD-(11052019)-1FD	N/A	Direct Fill	PFAS
		PICA-PSL-SW-2(11052019)	N/A	Direct Fill	PFAS
Area 1222 - Gorge	Groundwater	PICA-GRG-OD-3A(11082019)	10	low-flow	PFAS
		PICA-GRG-OD-5A(11082019)	18	low-flow	PFAS
		PICA-GRG-0D-6A-03052020	19	low-flow	PFAS
	Surface Water	PICA-GRG-SW-7(11082019)	N/A	Direct Fill	PFAS
		PICA-GRG-SW-8(11082019)	N/A	Direct Fill	PFAS
	Soil	PICA-GRG-SO-06-0-0.5-(12122019)	0.0-0.5	Sonic	PFAS
Lawn to the North of Building 3409/3410	Groundwater	PICA-LAW-TW-4(12052019)	28	Sonic / low-flow	PFAS
		PICA-LAW-TW-5(12052019)	25	Sonic / low-flow	PFAS
	Surface Water	PICA-LAW-SW-5-(11052019)	N/A	Direct Fill	PFAS
	Soil	PICA-LAW-SO-04-0-0.5(12032019)	0.0-0.5	Sonic	PFAS
		PICA-LAW-SO-04-7.0-7.5(12042019)	7.0-7.5	Sonic	PFAS
Former Building 24	Groundwater	PTA-CP-9-A-091718-N	15	low-flow	PFAS
		PTA-CP-9-C-091718-N	15	low-flow	PFAS
Post Farm Landfill	Groundwater	PICA-PFL-MW-1-(11152019)	47	low-flow	PFAS
		PICA-PFL-MW-2-(11142019)	40	low-flow	PFAS
		PICA-PFL-TW-2-(12102019)	40	Sonic / low-flow	PFAS
Former Wastewater Treatment Plant Facility	Groundwater	PTA-WWPT-38MW-1-091918-N	76	low-flow	PFAS
		PTA-WWPT-MW70-1A-091918-N	14	low-flow	PFAS
		PICA-WWTP-12E(11062019)	18	low-flow	PFAS
		PICA-WWTP-80-1(11062019) / FD(11062019)-2FD	30	low-flow	PFAS
		PICA-WWTP-80-3(11062019)	49	low-flow	PFAS
	Surface Water	PICA-WWTP-SW-3(11062019)	N/A	Direct Fill	PFAS
		PICA-WWTP-SW-4(11062019)	N/A	Direct Fill	PFAS
	Soil	PICA-WTP-SO-02-0-0.5(12122019)	0.0-0.5	Sonic	PFAS
Building 3801 – New Jersey Army National Guard Helipad Area	Groundwater	PICA-HEL-175MW-1(11122019) / PICA-FD-(11122019)-3FD	48	low-flow	PFAS
		PICA-HEL-175MW-2(11122019)	38	low-flow	PFAS
	Surface Water	PICA-HEL-SW-6(11122019)	N/A	Direct Fill	PFAS
	Soil	PICA-HEL-SO-05-0-0.5(12062019)	0.0-0.5	Sonic	PFAS
		PICA-HEL-SO-05-9.5-10.0(12062019)	9.5-10.0	Sonic	PFAS

Table 4-1 - Site Inspection Sampling Location Details
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Non-AOPI	Matrix	Sample ID	Depth Interval (ft bgs)	Sample Method	Analytes
Eastern Boundary	Groundwater	PICA-EAB-MW-26S(11142019)	8	low-flow	PFAS
		PICA-EAB-MW-27S(11142019)	14	low-flow	PFAS
		PICA-EAB-MW-28S(11142019)	14	low-flow	PFAS
		PICA-EAB-MW-29S(11132019)	8	low-flow	PFAS
		PICA-EAB-TW-9S-03032020	5.5	Sonic / low-flow	PFAS
		PICA-EAB-TW-9D-03042020	43	Sonic / low-flow	PFAS
	Surface Water	PICA-EAB-SW-9(11132019)	N/A	Direct Fill	PFAS
		PICA-EAB-SW-10(11132019)	N/A	Direct Fill	PFAS
		PICA-EAB-SW-12-03022020	N/A	Direct Fill	PFAS
Southern Boundary	Groundwater	PTA-SAB-SB1-1-091418-N	87	low-flow	PFAS
		PTA-SAB-SB1-2-091418-N	14	low-flow	PFAS
		PTA-SAB-SB1-3-091418-N	30	low-flow	PFAS
		PTA-SAB-SB2-1A-091218-N	160	low-flow	PFAS
		PTA-SAB-SB2-2-091218-N	32	low-flow	PFAS
		PTA-SAB-SB2-3-091218-N	247.5	low-flow	PFAS
		PTA-SAB-SB3-1B-091718-N	330	low-flow	PFAS
		PTA-SAB-SB3-2-091718-N	175	low-flow	PFAS
Southern Boundary	Groundwater	PTA-SAB-SB3-3-091718-N	28	low-flow	PFAS
		PTA-SAB-SB4-1-091318-N	376	low-flow	PFAS
		PTA-SAB-SB4-2-091318-N	39	low-flow	PFAS
		PTA-SAB-SB4-3-091318-N / PTA-DUP-1-091318FD	97	low-flow	PFAS
		PTA-SAB-SB4-4-091318-N	168	low-flow	PFAS
	Surface Water	PTA-SAB-GPB-1-091418-N	N/A	Direct Fill	PFAS
Northern Boundary	Surface Water	PICA-NAB-SW-11-03042020	N/A	Direct Fill	PFAS
Mid-Valley Upgradient	Groundwater	PICA-MVU-171MW-12-(11042019) / PICA-FD-(11042019)-4FD	158.8	low-flow	PFAS
Off-Site Potable Wells	Potable Water	0.01A-exterior spigot back-081419	N/A (taken from tap)	Direct Fill	PFAS
		0.58A-interior basement spout-051519	N/A (taken from tap)	Direct Fill	PFAS
		0.58A-interior bottom apt bathroom sink-070319		Direct Fill	PFAS
		0.58A-interior top apt. kitchen sink-070319		Direct Fill	PFAS
		0.58A-interior business bathroom sink-070319		Direct Fill	PFAS
		0.94A-interior kitchen sink-081319	N/A (taken from tap, TWD - 134)	Direct Fill	PFAS
		0.95A-exterior spigot back-081319	N/A (taken from tap)	Direct Fill	PFAS
		0.97A-interior kitchen sink-081319	N/A (taken from tap)	Direct Fill	PFAS
		0.98A-exterior spigot front-081319	N/A (taken from tap, TWD - 120)	Direct Fill	PFAS
		0.98B-exterior spigot front-081419	N/A (taken from tap, TWD - 100)	Direct Fill	PFAS

Notes:

1. Depth units are reported in ft bgs unless otherwise noted. Sampling depth noted for existing monitoring wells indicates the depth at approximately the center of the saturated screened interval.
2. In addition to laboratory analytes, field parameters were measured for groundwater samples and include temperature, pH, conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential. Lithologic descriptions were logged continuously at soil boring locations, and for sediment sampling locations. Field parameters and lithological descriptions are shown on field sampling forms included in Appendix F.
3. The PFAS analyte group includes PFOS, PFOA, PFBS and 15 other PFAS constituents.
4. The potable water sample IDs are redacted to prevent property location identification. The sample ID was replaced with property location identifier comprised of the property location's distance in miles from the Picatinny Arsenal site boundary, the tap location sampled and the sample date. A letter was added to the location identifier to distinguish between locations if multiple wells were the same distance from the installation boundary. If well construction details were available, the total well depth (TWD) is provided in the depth interval column.

AFFF = aqueous film forming foam
AOPI = Area of Potential Interest
ft bgs = feet below ground surface
GW = groundwater
ID = identification
N/A = not available or not applicable
PFAS = per- and polyfluoroalkyl substances
SO = soil
SW = surface water
TOC = total organic carbon

Table 5-1 - Groundwater PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Site Inspection
Picatinny Arsenal, New Jersey

					Analyte	PFOS (ng/l)		PFOA (ng/l)		PFBS (ng/L)	
					HAL	70		70		70	
					OSD Tapwater RSL, HQ=0.1	40		40		40000	
					OSD Tapwater RSL, HQ=0.1	400		400		400000	
Associated AOPI	Location Type	Location	Sample ID / Parent Sample ID	Sample Date	Sample Type	Result	Qual	Result	Qual	Result	Qual
Building 169 - Firehouse 1	Monitoring Well	104MW-2	PTA-FH1-104-MW2-091118-N	09/11/2018	N	**46**		**21**		**14**	
Buildings 3316/3321 – Firehouse 2	Monitoring Well	3316-3	PICA-FH2-3316-3-(11052019)	11/05/2019	N	**4900**	D	**110**		**140**	
	Monitoring Well	TW-3	PICA-FH2-TW-3-(12112019)	12/11/2019	N	**50000**	EDJ	**1000**	J	**1300**	
Former Pyrotechnic Area and Sanitary Landfill	Monitoring Well	20/24MW-18	PTA-20/24-MW18-091118-N	09/11/2018	N	5.0	U	**7.3**		5.0	U
	Monitoring Well	20/24MW-3	PTA-20/24-MW3-091118-N	09/11/2018	N	**4.2**	J	**26**		5.0	U
	Monitoring Well	20/24MW-8	PTA-20/24-MW8-091118-N	09/11/2018	N	**7.4**		**70**		5.0	U
Former Lower Burning Grounds	Monitoring Well	1179-1	PTA-LBG-1179-1-091918-N	09/19/2018	N	1.9	U	1.9	U	1.9	U
	Monitoring Well	1179-4B	PICA-PSL-1179-4B-(11052019)	11/05/2019	N	1.6	U	1.6	U	1.6	U
	Monitoring Well	1179-7	PICA-PSL-1179-7-(11052019)	11/05/2019	N	1.9	U	**8.2**		1.9	U
	Monitoring Well	1179A-1	PTA-DUP-2-091918FD / PTA-LBG-1179A-1-091918-N	09/19/2018	FD	9.9	U	**15**		9.9	U
			PTA-LBG-1179A-1-091918-N	09/19/2018	N	9.8	U	**15**		9.8	U
	Monitoring Well	1179A-2	PTA-LBG-1179A-2-091918-N	09/19/2018	N	9.9	U	**26**		9.9	U
Area 1222 - Gorge	Monitoring Well	OD-3A	PICA-GRG-OD-3A(11082019)	11/08/2019	N	**83**		**7.3**		**15**	
	Monitoring Well	OD-5A	PICA-GRG-OD-5A(11082019)	11/08/2019	N	**5.1**		**2.8**		**1.8**	
	Monitoring Well	OD-6A	PICA-GRG-0D-6A-03052020	03/05/2020	N	**35**		**1.6**	J	**12**	
Lawn to the North of Building 3409/3410	Monitoring Well	TW-4	PICA-LAW-TW-4(12052019)	12/05/2019	N	**200**	D	**47**		**80**	
	Monitoring Well	TW-5	PICA-LAW-TW-5(12052019)	12/05/2019	N	**12**		**10**		**2.3**	
Former Building 24	Monitoring Well	9-A	PTA-CP-9-A-091718-N	09/17/2018	N	**21**		**2.4**	J	**2.1**	J
	Monitoring Well	9-C	PTA-CP-9-C-091718-N	09/17/2018	N	**50**		**13**		**5.8**	
Post Farm Landfill	Monitoring Well	23MW-1	PICA-PFL-MW-1-(11152019)	11/15/2019	N	**1.4**	J	**1.5**	J	1.6	U
	Monitoring Well	23MW-2	PICA-PFL-MW-2-(11142019)	11/14/2019	N	**1.2**	J	**2.3**	J	1.6	U
	Monitoring Well	TW-2	PICA-PFL-TW-2-(12102019)	12/10/2019	N	**3.6**		**4.6**		1.8	U
Former Wastewater Treatment Plant Facility	Monitoring Well	38MW-1	PTA-WWPT-38MW-1-091918-N	09/19/2018	N	9.8	U	9.8	U	9.8	U
	Monitoring Well	80-1	FD(11062019)-2FD / PICA-WWTP-80-1(11062019)	11/06/2019	FD	**5.3**		**13**		**1.6**	J
			PICA-WWTP-80-1(11062019)	11/06/2019	N	**5.3**		**12**		**1.5**	J
	Monitoring Well	80-3	PICA-WWTP-80-3(11062019)	11/06/2019	N	**6.8**		**10**		**2.9**	
	Monitoring Well	MW-12E	PICA-WWTP-12E(11062019)	11/06/2019	N	**3.2**		**9.6**		**1.1**	J
	Monitoring Well	MW70-1A	PTA-WWPT-MW70-1A-091918-N	09/19/2018	N	**6.7**	J	**8.0**	J	10	U
Building 3801 – New Jersey Army National Guard Helipad Area	Monitoring Well	175MW-1	PICA-FD-(11122019)-3FD / PICA-HEL-175MW-1(11122019)	11/12/2019	FD	**10**		**8.6**		**1.1**	J
			PICA-HEL-175MW-1(11122019)	11/12/2019	N	**9.6**		**8.1**		**1.1**	J
	Monitoring Well	175MW-2	PICA-HEL-175MW-2(11122019)	11/12/2019	N	**32**		**12**		**5.3**	

Table 5-1 - Groundwater PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Site Inspection
Picatinny Arsenal, New Jersey

					Analyte	PFOS (ng/l)		PFOA (ng/l)		PFBS (ng/L)	
					HAL	70		70		70	
					OSD Tapwater RSL, HQ=0.1	40		40		40000	
					OSD Tapwater RSL, HQ=0.1	400		400		400000	
Associated AOPI	Location Type	Location	Sample ID / Parent Sample ID	Sample Date	Sample Type	Result	Qual	Result	Qual	Result	Qual
Eastern Boundary On-Site	Monitoring Well	RTI-MW-26S	PICA-EAB-MW-26S(11142019)	11/14/2019	N	**0.97**	J	**1.2**	J	1.7	U
	Monitoring Well	RTI-MW-27S	PICA-EAB-MW-27S(11142019)	11/14/2019	N	**5.6**		**120**		1.7	U
	Monitoring Well	RTI-MW-28S	PICA-EAB-MW-28S(11142019)	11/14/2019	N	1.6	U	**1.2**	J	1.6	U
	Monitoring Well	RTI-MW-29S	PICA-EAB-MW-29S(11132019)	11/13/2019	N	2.2	U	**4.0**	J	2.2	U
	Monitoring Well	TW-9D	PICA-EAB-TW-9D-03042020	03/04/2020	N	**0.95**	J	**4.2**	J	1.9	U
	Monitoring Well	TW-9S	PICA-EAB-TW-9S-03032020	03/03/2020	N	**42**		**7.9**		**7.5**	
Mid-Valley Upgradient On-Site	Monitoring Well	171MW-12	PICA-FD-(11042019)-4FD / PICA-MVU-171MW-12-(11042019)	11/04/2019	FD	1.6	U	1.6	U	1.6	U
			PICA-MVU-171MW-12-(11042019)	11/04/2019	N	1.6	U	1.6	UJ	1.6	UJ
Southern Area Boundary	Monitoring Well	SB1-1	PTA-SAB-SB1-1-091418-N	09/14/2018	N	**3.4**		**4.2**		1.8	U
	Monitoring Well	SB1-2	PTA-SAB-SB1-2-091418-N	09/14/2018	N	**300**	D	**14**		**6.7**	
	Monitoring Well	SB1-3	PTA-SAB-SB1-3-091418-N	09/14/2018	N	**49**		**7.3**		**1.4**	J
	Monitoring Well	SB2-1A	PTA-SAB-SB2-1A-091218-N	09/12/2018	N	1.7	UB	**5.4**		1.7	U
	Monitoring Well	SB2-2	PTA-SAB-SB2-2-091218-N	09/12/2018	N	**6.8**	J	**18**		9.9	U
	Monitoring Well	SB2-3	PTA-SAB-SB2-3-091218-N	09/12/2018	N	1.8	U	1.8	U	1.8	U
	Monitoring Well	SB3-1B	PTA-SAB-SB3-1B-091718-N	09/17/2018	N	1.8	U	1.8	U	1.8	U
	Monitoring Well	SB3-2	PTA-SAB-SB3-2-091718-N	09/17/2018	N	**87**		**6.7**		**3.5**	
	Monitoring Well	SB3-3	PTA-SAB-SB3-3-091718-N	09/17/2018	N	4.9	UB	**8.9**		**2.3**	
	Monitoring Well	SB4-1	PTA-SAB-SB4-1-091318-N	09/13/2018	N	1.7	UB	**4.8**		1.7	U
	Monitoring Well	SB4-2	PTA-SAB-SB4-2-091318-N	09/13/2018	N	1.7	UB	**5.5**		1.7	U
	Monitoring Well	SB4-3	PTA-DUP-1-091318FD / PTA-SAB-SB4-3-091318-N	09/13/2018	FD	**12**		**19**		9.9	U
			PTA-SAB-SB4-3-091318-N	09/13/2018	N	**15**		**18**		10	U
	Monitoring Well	SB4-4	PTA-SAB-SB4-4-091318-N	09/13/2018	N	1.8	U	1.8	U	1.8	U

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection.
2. Gray shaded values indicate the result was detected greater than the 2019 Office of the Secretary of Defense (OSD) risk screening levels (OSD. 2019. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. October.). In the presence of only one PFAS, a hazard quotient (HQ) = 1.0 is used; in the presence of multiple PFAS, a HQ = 0.1 is used.
3. Underlined values indicate the result was detected greater than the 2016 United States Environmental Protection Agency (USEPA) lifetime health advisory (LHA) of 70 ng/L PFOS, PFOA, or the sum of PFOS and PFOA.

Acronyms/Abbreviations:
-- = not applicable
AOPI = Area of Potential Interest
CAS = Chemical Abstract Service Number
FD = field duplicate sample
ID = identification
N = primary sample
ng/L = nanograms per liter (parts per trillion)
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Qualifier - Description
D - The analyte was analyzed at dilution
E - The reported result is above the limit of the calibration range
J - The analyte was positively identified; however, the associated numerical value is an estimated concentration only
U - The analyte was analyzed for but the result was not detected above the limit of quantitation (LOQ)
UB - The analyte is considered nondetect at the listed value due to associated blank contamination
UJ - The analyte was analyzed for but was not detected. The reported LOQ is approximate and may be inaccurate or imprecise

Table 5-2 - Surface Water PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Site Inspection
Picatinny Arsenal, New Jersey

					Analyte	PFOS (ng/l)		PFOA (ng/l)		PFBS (ng/L)	
					HAL	70		70		70	
					OSD Tapwater RSL, HQ=0.1	40		40		40000	
					OSD Tapwater RSL, HQ=0.1	400		400		400000	
Associated AOPI	Location Type	Location	Sample ID / Parent Sample ID	Sample Date	Sample Type	Result	Qual	Result	Qual	Result	Qual
Former Lower Burning Grounds	Surface Water/Seep	SW-1	PICA-FD-(11052019)-1FD / PICA-PSL-SW-1-(11052019)	11/05/2019	FD	**60**		**8.0**		**6.7**	
			PICA-PSL-SW-1-(11052019)	11/05/2019	N	**72**	J	**9.5**		**7.6**	
	Surface Water/Seep	SW-2	PICA-PSL-SW-2(11052019)	11/05/2019	N	**65**		**8.1**		**6.5**	
Area 1222 - Gorge	Surface Water/Seep	SW-7	PICA-GRG-SW-7(11082019)	11/08/2019	N	1.7	U	1.7	U	1.7	U
	Surface Water/Seep	SW-8	PICA-GRG-SW-8(11082019)	11/08/2019	N	**12**		**2.7**		**2.1**	
Lawn to the North of Building 3409/3410	Surface Water/Seep	SW-5	PICA-LAW-SW-5-(11052019)	11/05/2019	N	**4100**	D	**78**	J	**230**	D
Former Wastewater Treatment Plant Facility	Surface Water/Seep	SW-3	PICA-WWTP-SW-3(11062019)	11/06/2019	N	**56**		**7.4**		**7.4**	
	Surface Water/Seep	SW-4	PICA-WWTP-SW-4(11062019)	11/06/2019	N	**4.6**		**9.4**		**2.0**	J
Building 3801 – New Jersey Army National Guard Helipad Area	Surface Water/Seep	SW-6	PICA-HEL-SW-6(11122019)	11/12/2019	N	**160**	D	**11**		**4.1**	
Eastern Boundary On-Site	Surface Water/Seep	SW-10	PICA-EAB-SW-10(11132019)	11/13/2019	N	**1.7**		**6.5**		**1.1**	J
	Surface Water/Seep	SW-12	PICA-EAB-SW-12-03022020	03/02/2020	N	**79**		**5.1**		**9.9**	
	Surface Water/Seep	SW-9	PICA-EAB-SW-9(11132019)	11/13/2019	N	**1.5**	J	**7.8**		1.9	U
Northern Boundary On-Site	Surface Water/Seep	SW-11	PICA-NAB-SW-11-03042020	03/04/2020	N	1.8	U	**2.0**		1.8	U
Southern Area Boundary	Surface Water/Seep	GPB-1	PTA-SAB-GPB-1-091418-N	09/14/2018	N	**130**		**13**		**9.1**	

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection.
2. Gray shaded values indicate the result was detected greater than the 2019 Office of the Secretary of Defense (OSD) risk screening levels (OSD. 2019. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. October.). In the presence of only one PFAS, a hazard quotient (HQ) = 1.0 is used; in the presence of multiple PFAS, a HQ = 0.1 is used.
3. Underlined values indicate the result was detected greater than the 2016 United States Environmental Protection Agency (USEPA) lifetime health advisory (LHA) of 70 ng/L PFOS, PFOA, or the sum of PFOS and PFOA.

Acronyms/Abbreviations:
-- = not applicable
AOPI = Area of Potential Interest
CAS = Chemical Abstract Service Number
FD = field duplicate sample
ID = identification
N = primary sample
ng/L = nanograms per liter (parts per trillion)
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Qualifier - Description
D - The analyte was analyzed at dilution
E - The reported result is above the limit of the calibration range
J - The analyte was positively identified; however, the associated numerical value is an estimated concentration only
U - The analyte was analyzed for but the result was not detected above the limit of quantitation (LOQ)
UB - The analyte is considered nondetect at the listed value due to associated blank contamination
UJ - The analyte was analyzed for but was not detected. The reported LOQ is approximate and may be inaccurate or imprecise

Table 5-3 - Soil PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Site Inspection
Picatinny Arsenal, New Jersey

			Analyte		PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)	
			OSD Residential RSL, HQ=0.1		0.13		0.13		130	
			OSD Residential RSL, HQ=1.0		1.3		1.3		1300	
Associated AOPI	Location Type	Location	Sample ID / Parent Sample ID	Sample Date	Sample Type	Result	Qual	Result	Qual	Result	Qual
Buildings 3316/3321 – Firehouse 2	Soil	SO-03	PICA-FD-SO-(12112019)-1FD / PICA-FH2-SO-9.0-9.5(12112019)	12/11/2019	FD	**0.059**	J	0.00064	U	0.0021	U
			PICA-FH2-SO-03-0-0.5(12112019)	12/11/2019	N	**0.18**	D	**0.0013**		0.0025	U
			PICA-FH2-SO-9.0-9.5(12112019)	12/11/2019	N	**0.2**	DJ	**0.00045**	J	0.0021	U
Area 1222 - Gorge	Soil	SO-06	PICA-GRG-SO-06-0-0.5-(12122019)	12/12/2019	N	**0.0018**		0.00082	U	0.0027	U
Lawn to the North of Building 3409/3410	Soil	SO-04	PICA-LAW-SO-04-0-0.5(12032019)	12/03/2019	N	**0.0064**		0.00069	U	0.0023	U
			PICA-LAW-SO-04-7.0-7.5(12042019)	12/04/2019	N	0.00066	U	0.00066	U	0.0022	U
Former Wastewater Treatment Plant Facility	Soil	SO-02	PICA-WTP-SO-02-0-0.5(12122019)	12/12/2019	N	**0.0093**		**0.0097**		0.0081	U
Building 3801 – New Jersey Army National Guard Helipad Area	Soil	SO-05	PICA-HEL-SO-05-0-0.5(12062019)	12/06/2019	N	**0.0008**		0.00066	U	0.0022	U
			PICA-HEL-SO-05-9.5-10.0(12062019)	12/06/2019	N	0.00063	U	0.00063	U	0.0021	U

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection
2. Grey shaded values indicate the concentrations are greater than the 2019 Office of the Secretary of Defense (OSD) risk screening levels for the residential scenario (OSD. 2019. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. October.). In the presence of only one PFAS, a hazard quotient (HQ) = 1.0 is used; in the presence of multiple PFAS, a HQ = 0.1 is used.

Acronyms/Abbreviations:
AOPI = Area of Potential Interest
FD = field duplicate sample
ID = identification
mg/kg = milligrams per kilogram (parts per billion)
N = primary sample
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
Qual = qualifier
RSL = risk screening level

Qualifier - Description
D - The analyte was analyzed at dilution
E - The reported result is above the limit of the calibration range
J - The analyte was positively identified; however, the associated numerical value is an estimated concentration only
U - The analyte was analyzed for but the result was not detected above the limit of quantitation (LOQ)
UB - The analyte is considered nondetect at the listed value due to associated blank contamination
UJ - The analyte was analyzed for but was not detected. The reported LOQ is approximate and may be inaccurate or imprecise

Table 5-4 - Off-Site Potable Groundwater PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Site Inspection
Picatinny Arsenal, New Jersey

			Analyte		PFOS (ng/l)		PFOA (ng/l)		PFBS (ng/L)	
			HAL		70		70		70	
			OSD Tapwater RSL, HQ=0.1		40		40		40000	
			OSD Tapwater RSL, HQ=0.1		400		400		400000	
Associated AOPI	Location Type	Location	Sample ID / Parent Sample ID	Sample Date	Sample Type	Result	Qual	Result	Qual	Result	Qual
Off-Site Potable Wells (non-AOPI)	Potable Well	0.58A	0.58A-interior basement spout-051519	05/15/2019	N	**25**		**14**		**5.1**	
	Potable Well	0.58A	0.58A-interior bottom apt bathroom sink-070319	07/03/2019	N	**20**		**12**		**5.2**	
	Potable Well	0.58A	0.58A-interior top apt. kitchen sink-070319	07/03/2019	N	**19**		**12**		**5.1**	
	Potable Well	0.58A	0.58A-interior business bathroom sink-070319	07/03/2019	N	**18**		**11**		**5.0**	
	Potable Well	0.94A	0.94A-interior kitchen sink-081319	08/13/2019	N	1.7	U	1.7	UJ	1.7	U
	Potable Well	0.95A	0.95A-exterior spigot back-081319	08/13/2019	N	**0.89**	J	**1.2**	J	1.8	U
	Potable Well	0.98B	0.98B-exterior spigot front-081419	08/14/2019	N	**0.92**	J	**1.0**	J	1.7	U
	Potable Well	0.98A	0.98A-exterior spigot front-081319	08/13/2019	N	1.8	U	1.8	UJ	1.8	U
	Potable Well	0.01A	0.01A-exterior spigot back-081419	08/14/2019	N	1.7	U	1.7	UJ	1.7	U
	Potable Well	0.97A	0.97A-interior kitchen sink-081319	08/13/2019	N	**2.3**		**2.6**	J	1.7	U

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection.
2. Gray shaded values indicate the result was detected greater than the 2019 Office of the Secretary of Defense (OSD) risk screening levels (OSD. 2019. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. October.). In the presence of only one PFAS, a hazard quotient (HQ) = 1.0 is used; in the presence of multiple PFAS, a HQ = 0.1 is used.
3. Underlined values indicate the result was detected greater than the 2016 United States Environmental Protection Agency (USEPA) lifetime health advisory (LHA) of 70 ng/L PFOS, PFOA, or the sum of PFOS and PFOA.
4. The potable water sample IDs are redacted to prevent property location identification. The sample ID was replaced with location identifier comprised of the property location distance in miles from the PICA site boundary, the tap location sampled and the sample date. A letter was added to the location identifier to distinguish between locations if multiple wells were the same distance from the installation boundary.

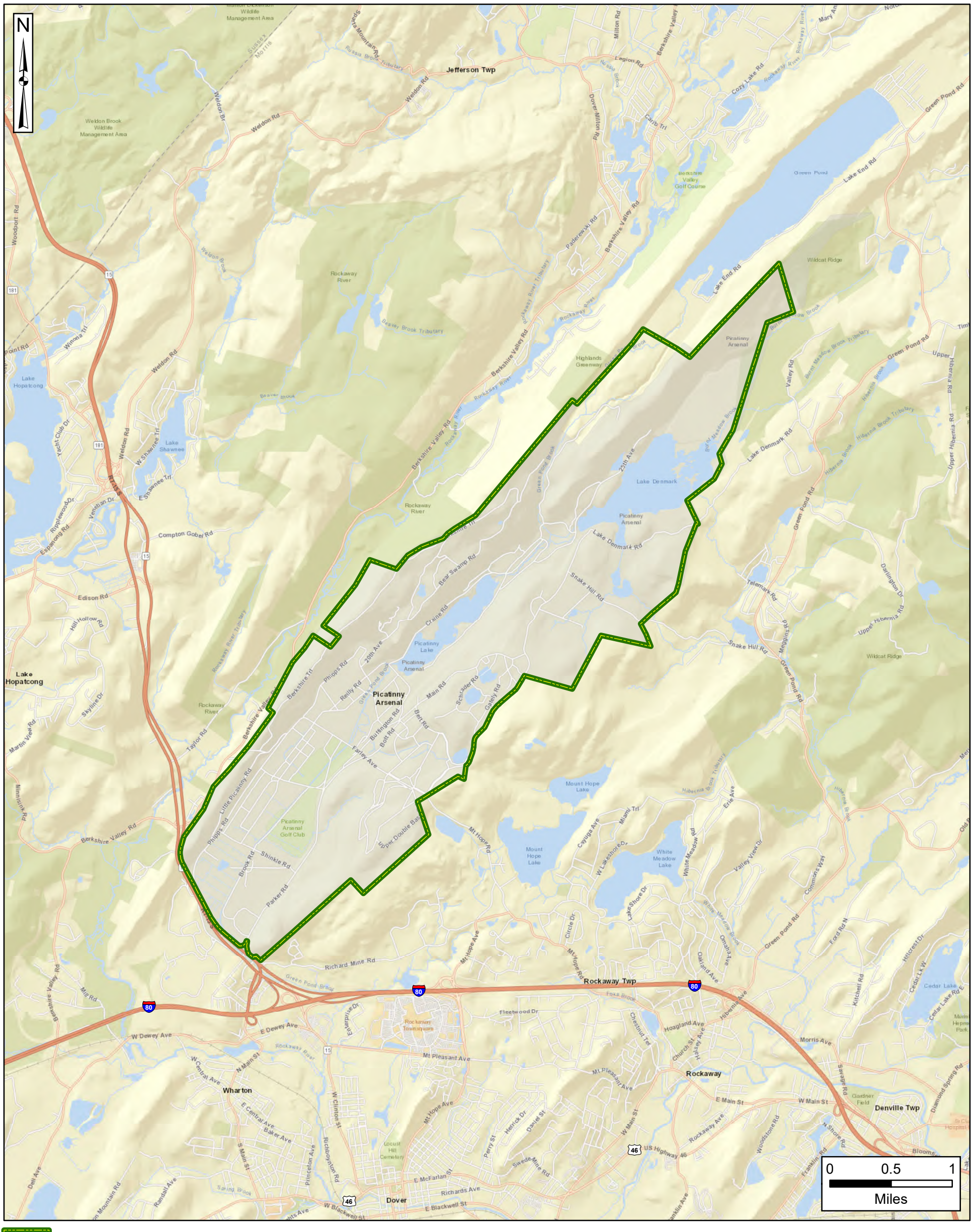
Acronyms/Abbreviations:
-- = not applicable
AOPI = Area of Potential Interest
CAS = Chemical Abstract Service Number
FD = field duplicate sample
ID = identification
N = primary sample
ng/L = nanograms per liter (parts per trillion)
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Qualifier - Description
D - The analyte was analyzed at dilution
E - The reported result is above the limit of the calibration range
J - The analyte was positively identified; however, the associated numerical value is an estimated concentration only
U - The analyte was analyzed for but the result was not detected above the limit of quantitation (LOQ)
UB - The analyte is considered nondetect at the listed value due to associated blank contamination
UJ - The analyte was analyzed for but was not detected. The reported LOQ is approximate and may be inaccurate or imprecise

FIGURES

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 2-1
Site Location



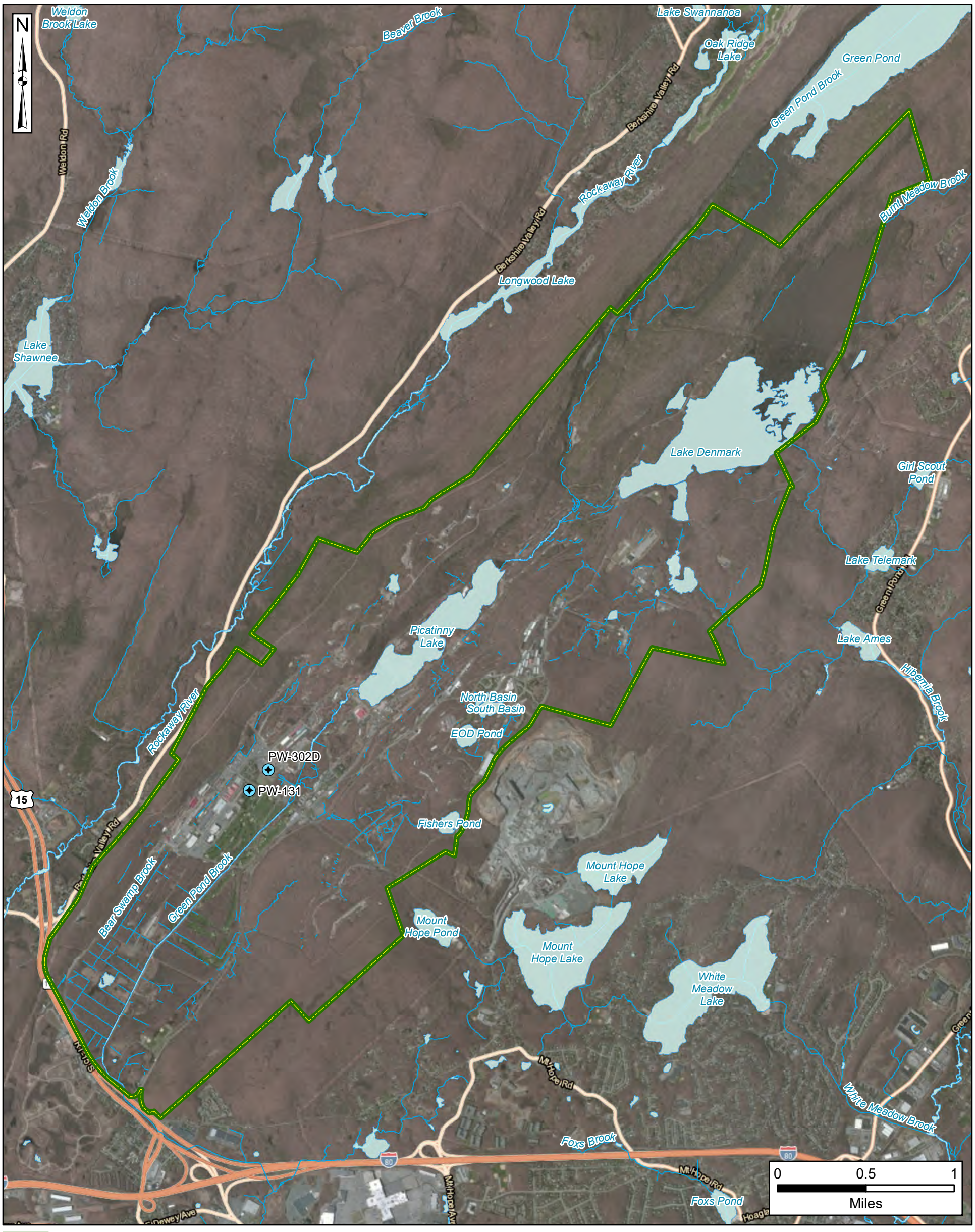
Installation Boundary

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 2-2
Site Layout



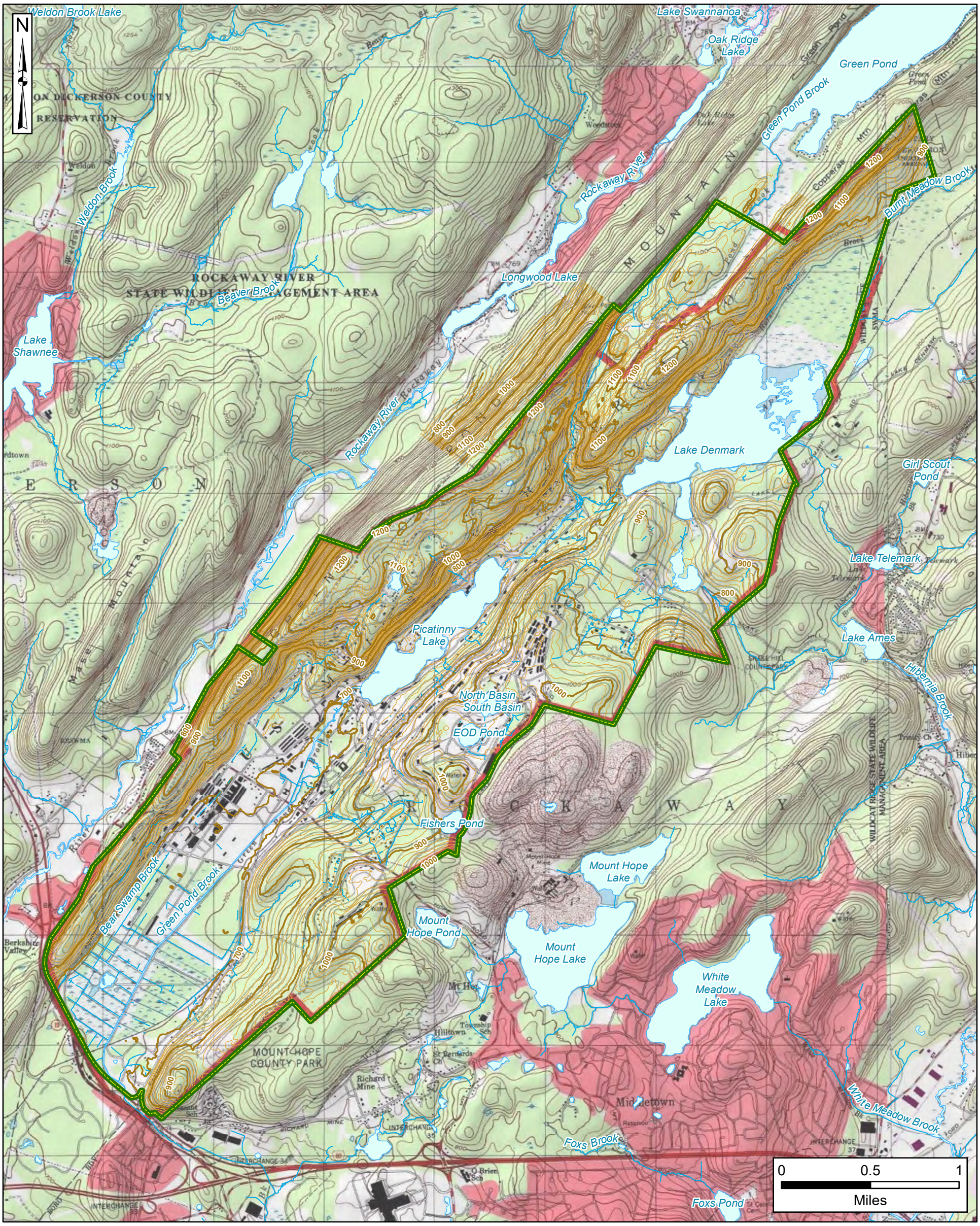
Installation Boundary
River/Stream
Water Body
Water Supply Well

Data Sources:
Picatinny Arsenal, GIS Data, 2018
CEA, Well Data, 2018
EDR, Well Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 2-3
Topographic Map



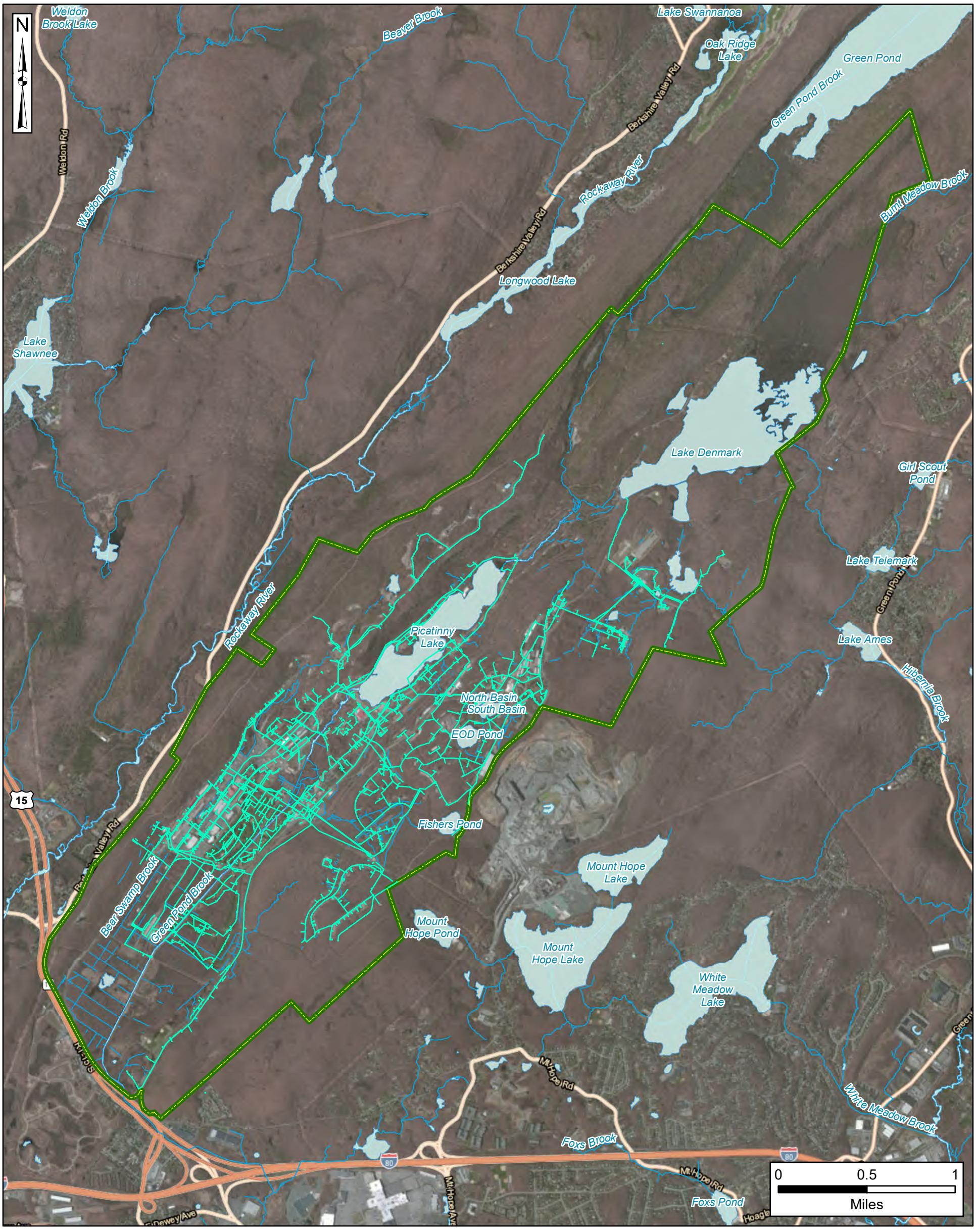
Installation Boundary
River/Stream
Water Body
Elevation Contour (Index) (ft)
Elevation Contour (Intermediate) (ft)

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, USGS Topo

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 2-4
Water Lines at PICA



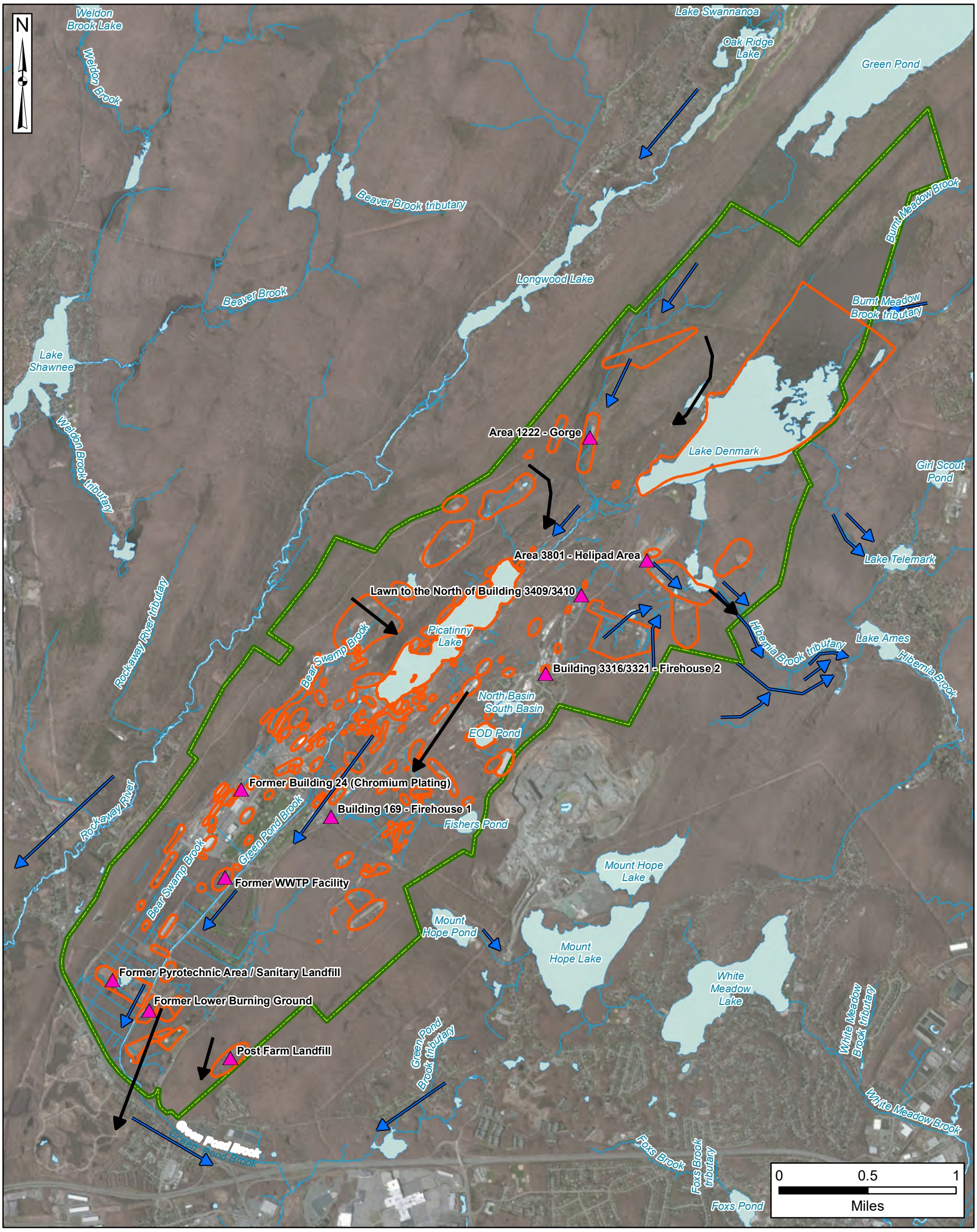
Installation Boundary
River/Stream
Water Body
Water Line

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 3-1
AOPI Locations



Installation Boundary
River/Stream
Water Body
Groundwater Flow Direction
Surface Water Flow Direction
AOPI Location
Installation Restoration Program Site Area (Shaw, 2008)

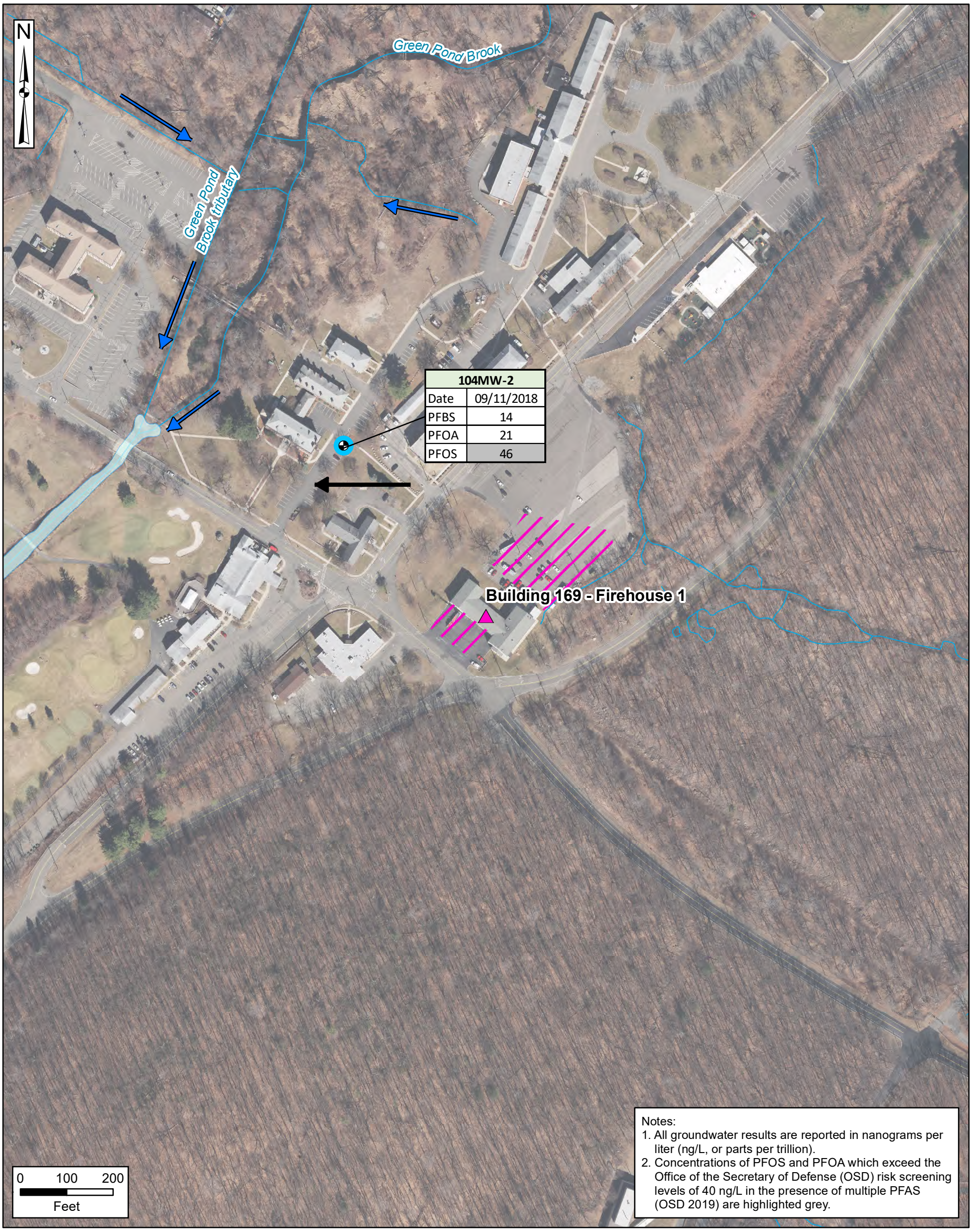
AOPI = area of potential interest

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 3-2
AOPI Building 169 - Firehouse 1
Sampling Results



AOPI Location
AFFF Use Area
River/Stream
Water Body
Surface Water Flow Direction
Assumed Groundwater Flow Direction
Well

Sample Locations

Groundwater (Existing Well)

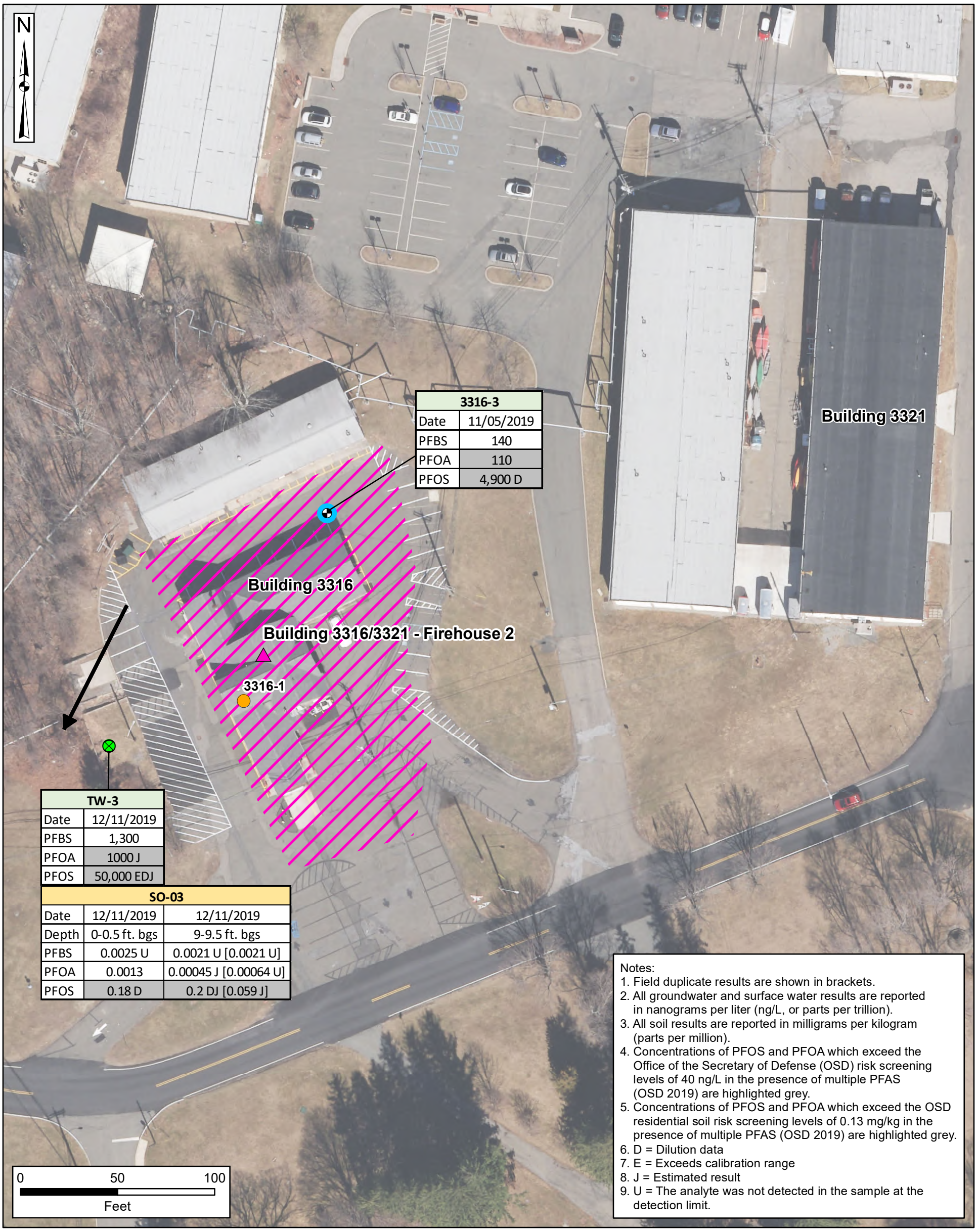
AFFF = aqueous film-forming foam
AOPI = area of potential interest

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 3-3
AOPI Building 3316/3321 - Firehouse 2
Sampling Results



3316-3	
Date	11/05/2019
PFBS	140
PFOA	110
PFOS	4,900 D

TW-3	
Date	12/11/2019
PFBS	1,300
PFOA	1000 J
PFOS	50,000 EDJ

SO-03		
Date	12/11/2019	12/11/2019
Depth	0-0.5 ft. bgs	9-9.5 ft. bgs
PFBS	0.0025 U	0.0021 U [0.0021 U]
PFOA	0.0013	0.00045 J [0.00064 U]
PFOS	0.18 D	0.2 DJ [0.059 J]

Notes:
1. Field duplicate results are shown in brackets.
2. All groundwater and surface water results are reported in nanograms per liter (ng/L, or parts per trillion).
3. All soil results are reported in milligrams per kilogram (parts per million).
4. Concentrations of PFOS and PFOA which exceed the Office of the Secretary of Defense (OSD) risk screening levels of 40 ng/L in the presence of multiple PFAS (OSD 2019) are highlighted grey.
5. Concentrations of PFOS and PFOA which exceed the OSD residential soil risk screening levels of 0.13 mg/kg in the presence of multiple PFAS (OSD 2019) are highlighted grey.
6. D = Dilution data
7. E = Exceeds calibration range
8. J = Estimated result
9. U = The analyte was not detected in the sample at the detection limit.

AOPI Location
AFFF Use Area
Assumed Groundwater Flow Direction
Well

Sample Locations
Soil/Groundwater (Temporary Well)
Groundwater (Existing Well)

Proposed Sampling Locations*
Groundwater (Existing Well)

AFFF = aqueous film-forming foam
AOPI = area of potential interest

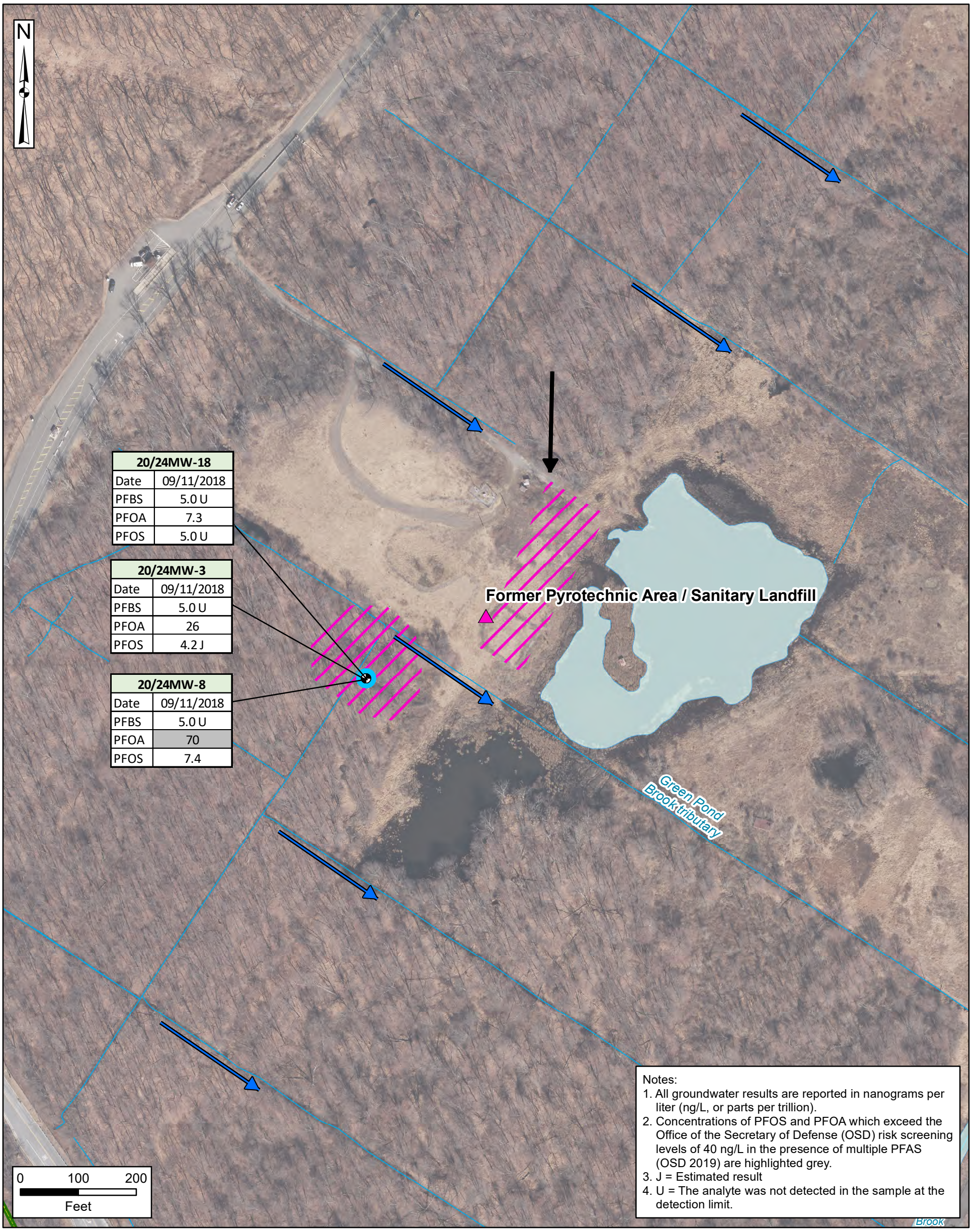
Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

* Proposed location not collected, see Non-Conformance Reports / Deviations Section in SI Report

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 3-4
AOPI Former Pyrotechnic Area / Sanitary Landfill
Sampling Results



AOPI Location
AFFF Use Area
River/Stream
Water Body
Surface Water Flow Direction
Assumed Groundwater Flow Direction
Well

Sample Locations

Groundwater (Existing Well)

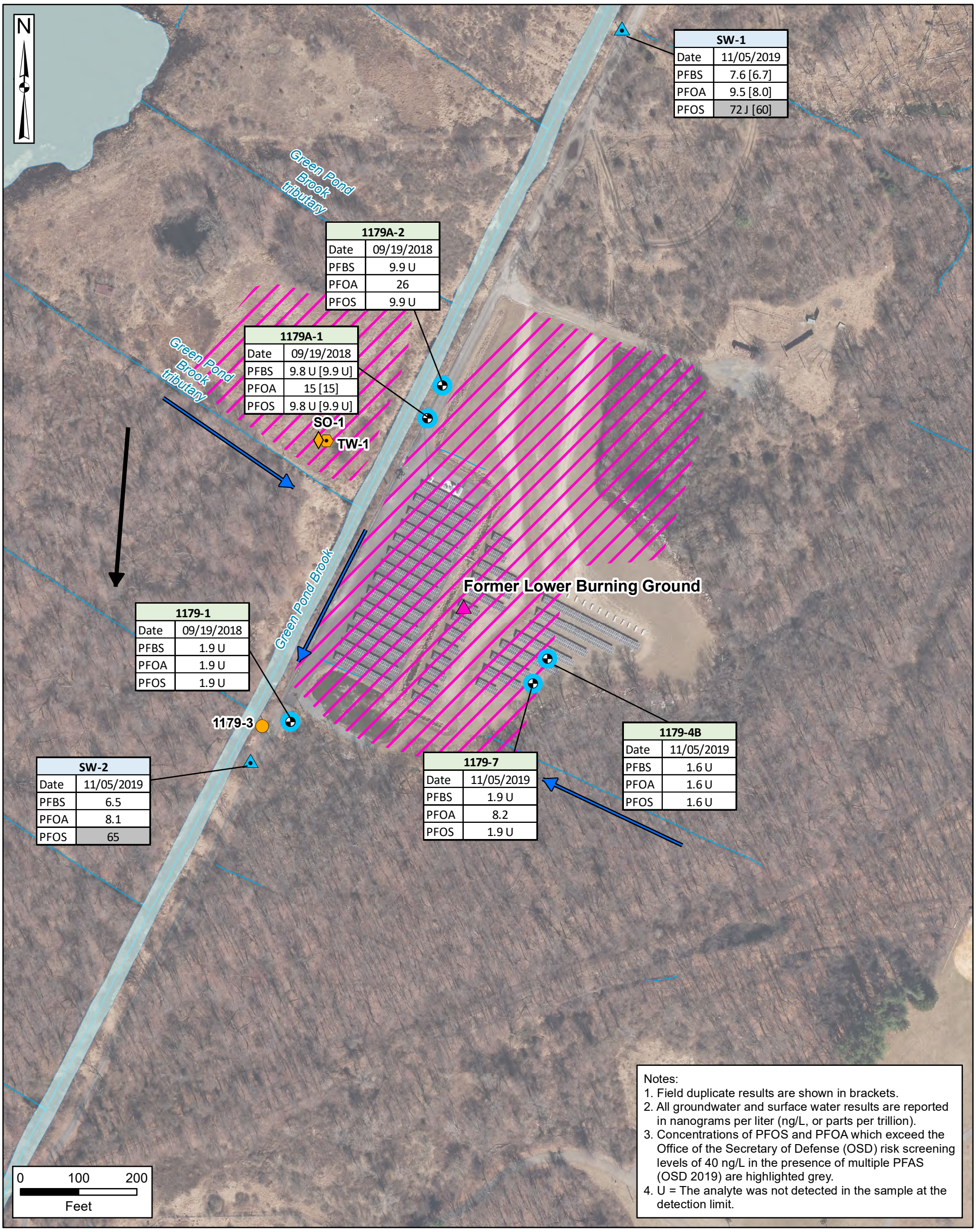
AFFF = aqueous film-forming foam
AOPI = area of potential interest

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 3-5
AOPI Former Lower Burning Grounds
Sampling Results



AOPI Location
AFFF Use Area
River/Stream
Water Body
Surface Water Flow Direction
Assumed Groundwater Flow Direction

Well

Sample Locations
Surface Water
Groundwater (Existing Well)

Proposed Sample Locations*
Soil
Groundwater (Temporary Well)
Groundwater (Existing Well)

AFFF = aqueous film-forming foam
AOPI = area of potential interest

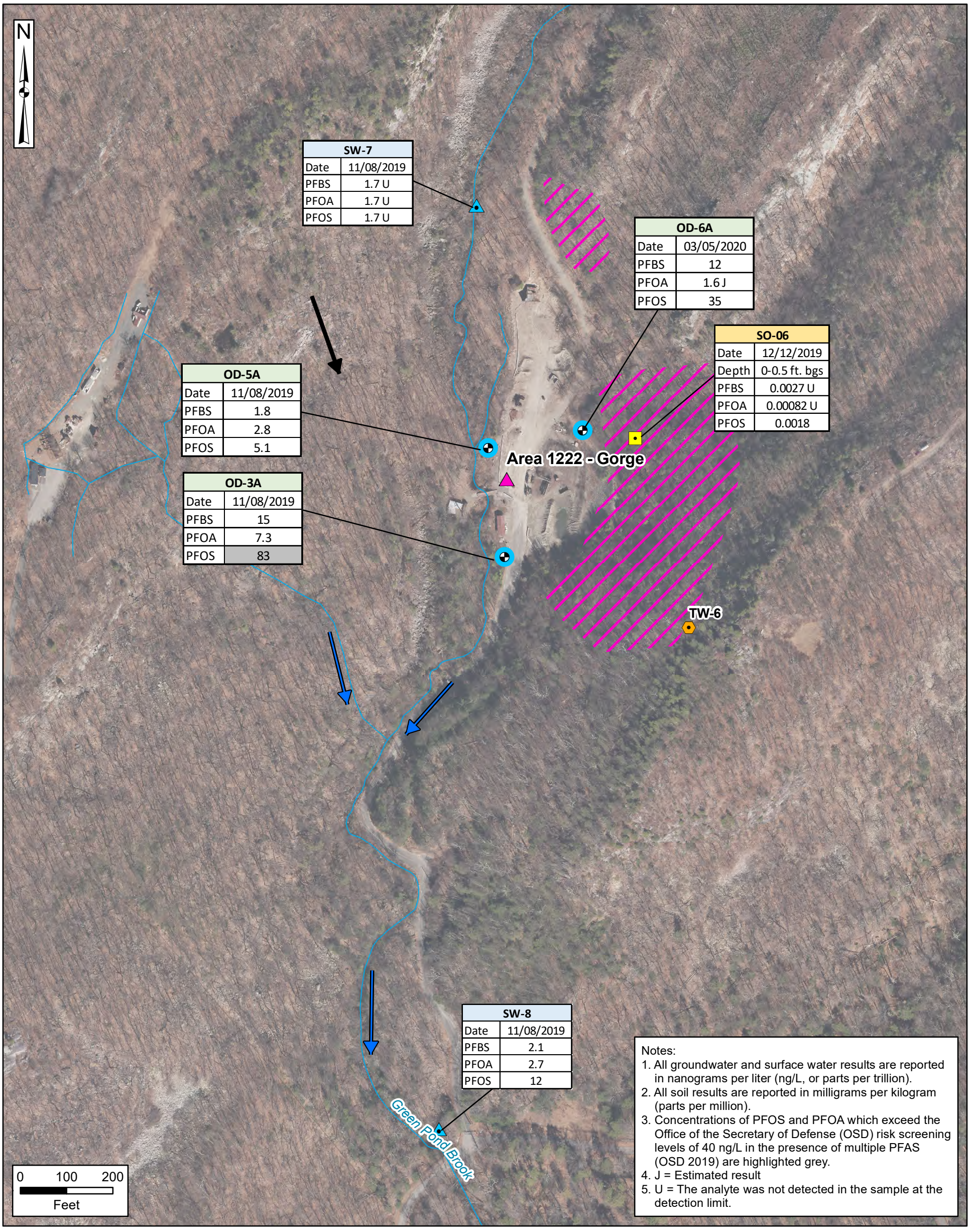
Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

* Proposed location not collected, see Non-Conformance Reports / Deviations Section in SI Report

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 3-6
AOPI Area 1222 - Gorge
Sampling Results



Notes:
1. All groundwater and surface water results are reported in nanograms per liter (ng/L, or parts per trillion).
2. All soil results are reported in milligrams per kilogram (parts per million).
3. Concentrations of PFOS and PFOA which exceed the Office of the Secretary of Defense (OSD) risk screening levels of 40 ng/L in the presence of multiple PFAS (OSD 2019) are highlighted grey.
4. J = Estimated result
5. U = The analyte was not detected in the sample at the detection limit.

AOPI Location
AFFF Use Area
River/Stream
Surface Water Flow Direction
Assumed Groundwater Flow Direction
Well

Sample Locations
Surface Water
Soil
Groundwater (Existing Well)

Proposed Sample Locations*
Groundwater (Temporoary Well)

* Proposed location not collected, see Non-Conformance Reports / Deviations Section in SI Report

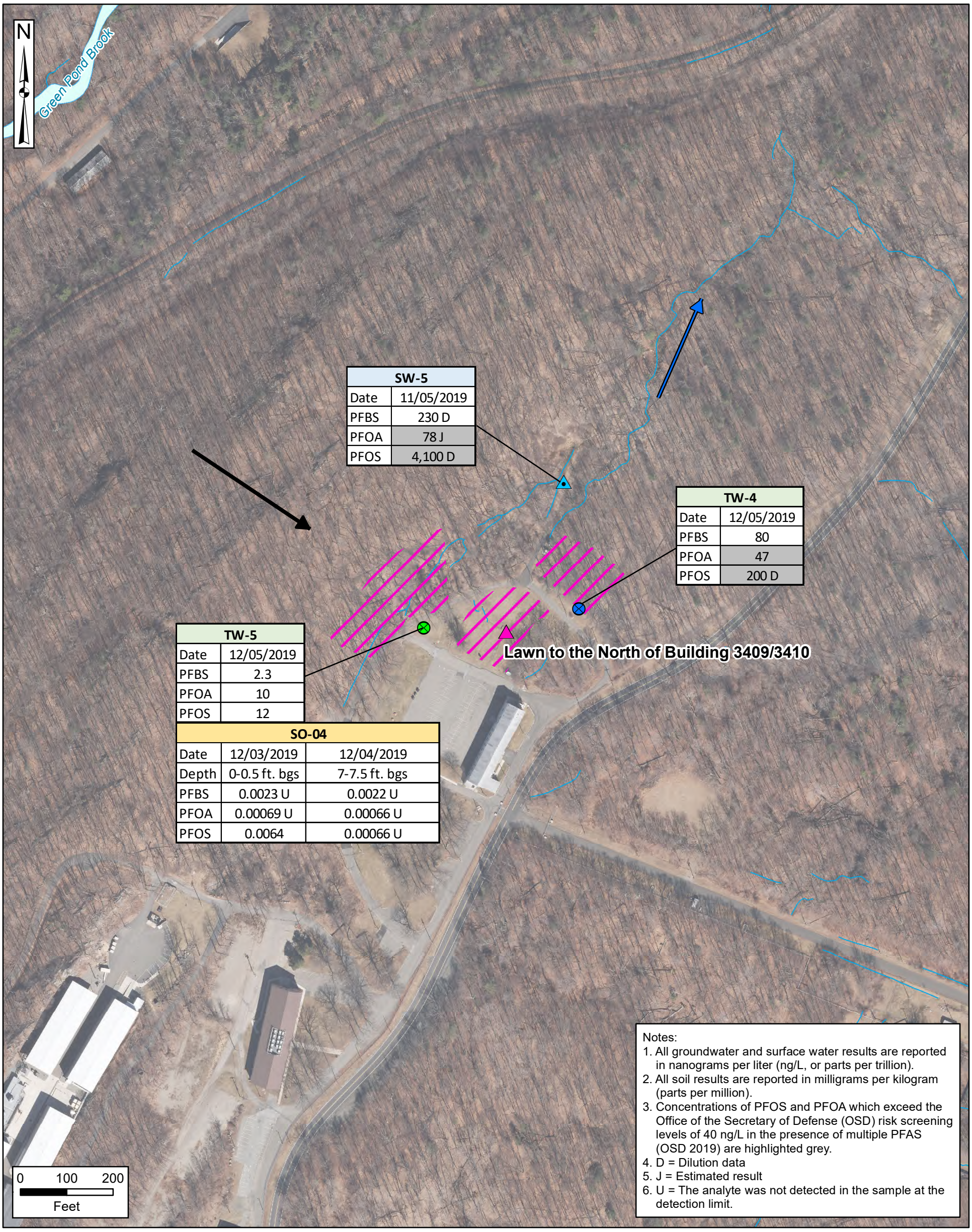
AFFF = aqueous film-forming foam
AOPI = area of potential interest

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 3-7
AOPI Lawn to the North of Building 3409/3410 Sampling Results



AOPI Location
AFFF Use Area
River/Stream
Surface Water Flow Direction
Assumed Groundwater Flow Direction

Sample Locations
Surface Water
Soil/Groundwater (Temporary Well)
Groundwater (Temporary Well)

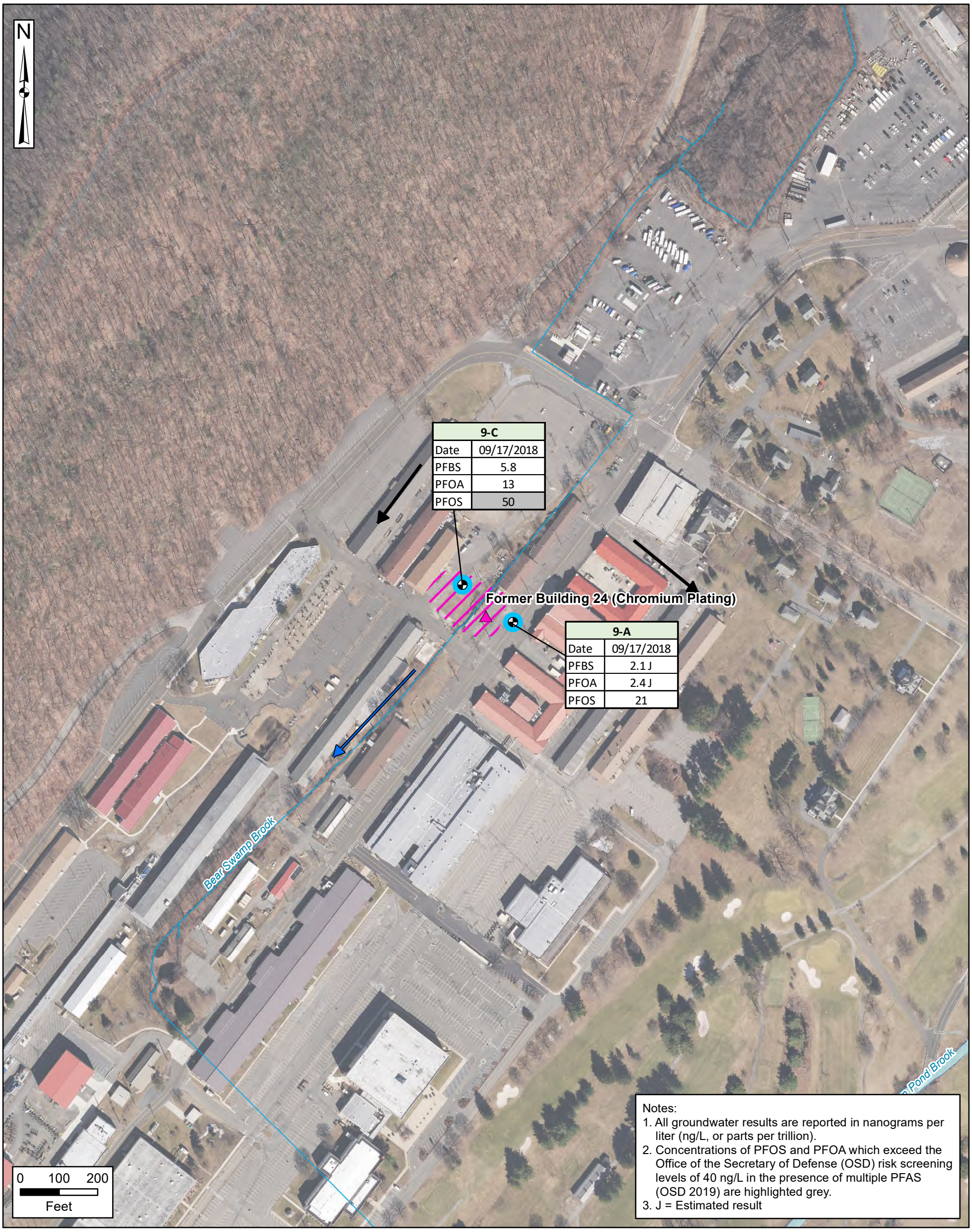
AFFF = aqueous film-forming foam
AOPI = area of potential interest

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 3-8
AOPI Former Building 24
Sampling Results



AOPI Location
AFFF Use Area
River/Stream
Water Body
Surface Water Flow Direction
Assumed Groundwater Flow Direction
Well

Sample Locations

Groundwater (Existing Well)

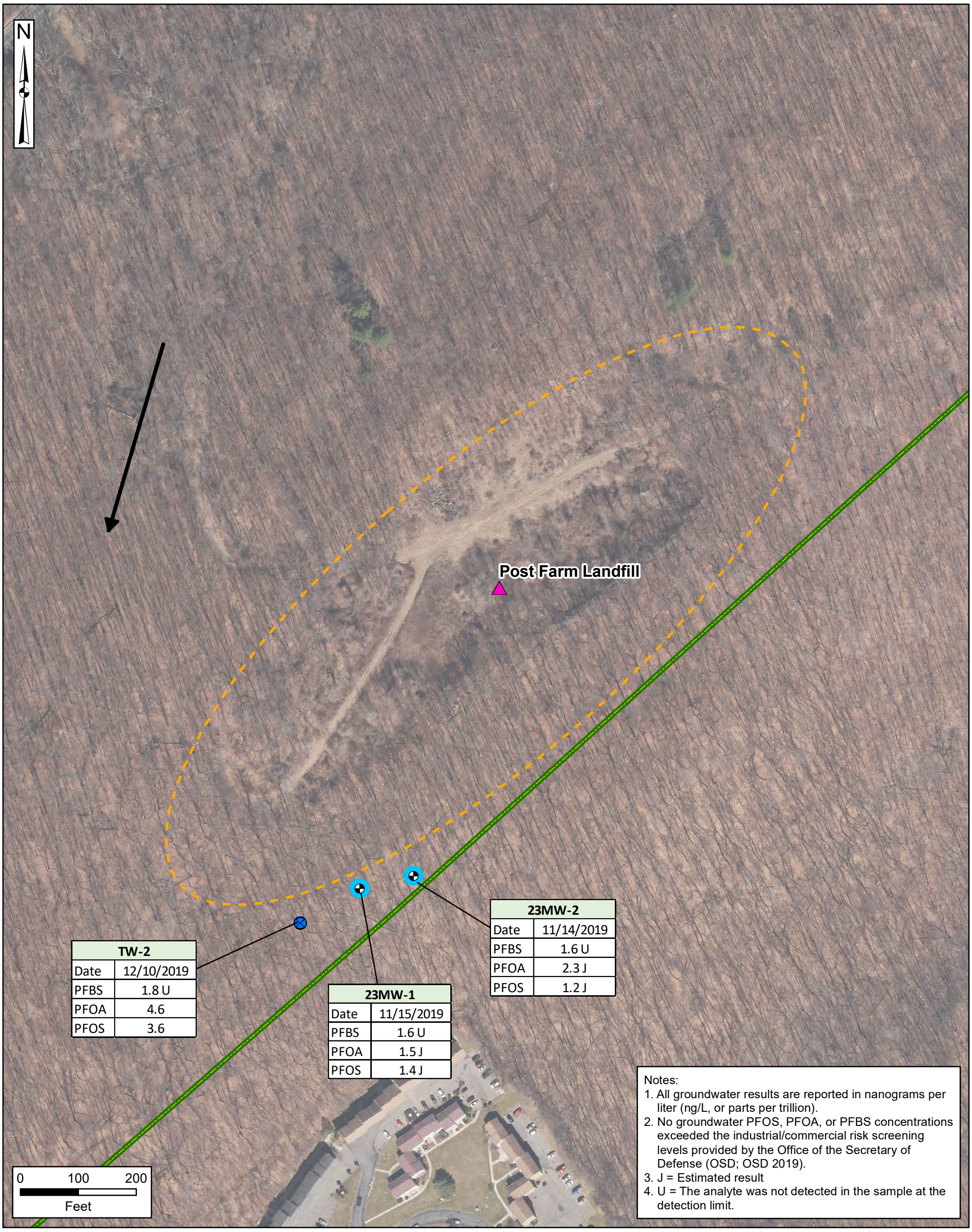
AFFF = aqueous film-forming foam
AOPI = area of potential interest

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 3-9
AOPI Post Farm Landfill
Sampling Results



Installation Boundary
AOPI Location
Approx. Historical Dumping Area
Assumed Groundwater Flow Direction
Well

Sample Locations

Groundwater (Temporary Well)
Groundwater (Existing Well)

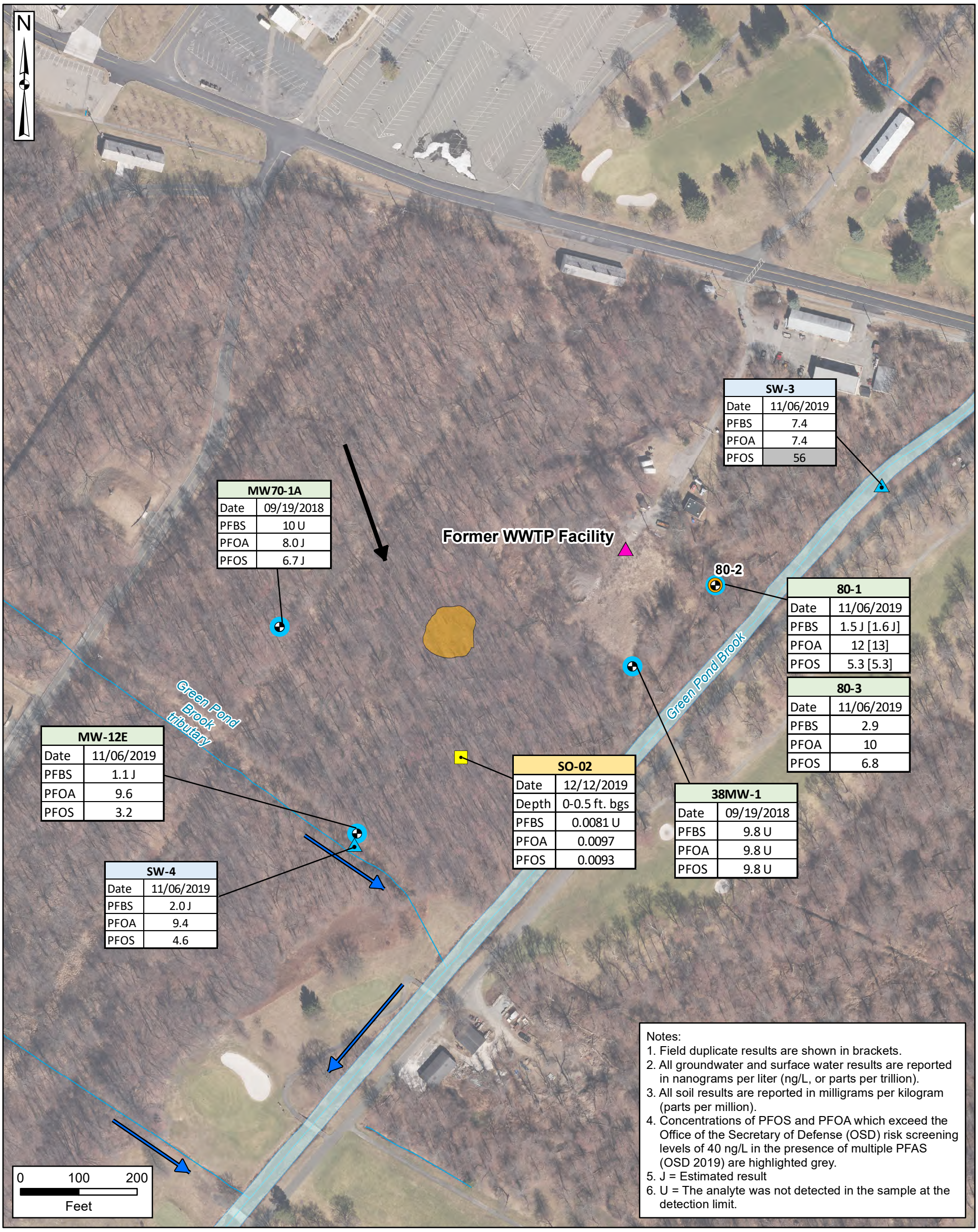
AOPI = area of potential interest

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 3-10
AOPI Former WWTP Facility
Sampling Results



AOPI Location
Approximate Location of Leach Fields
River/Stream
Water Body
Surface Water Flow Direction
Assumed Groundwater Flow Direction

Well

Sample Locations
Surface Water
Soil
Groundwater (Existing Well)

Proposed Sample Locations*
Groundwater (Existing Well)

AOPI = area of potential interest

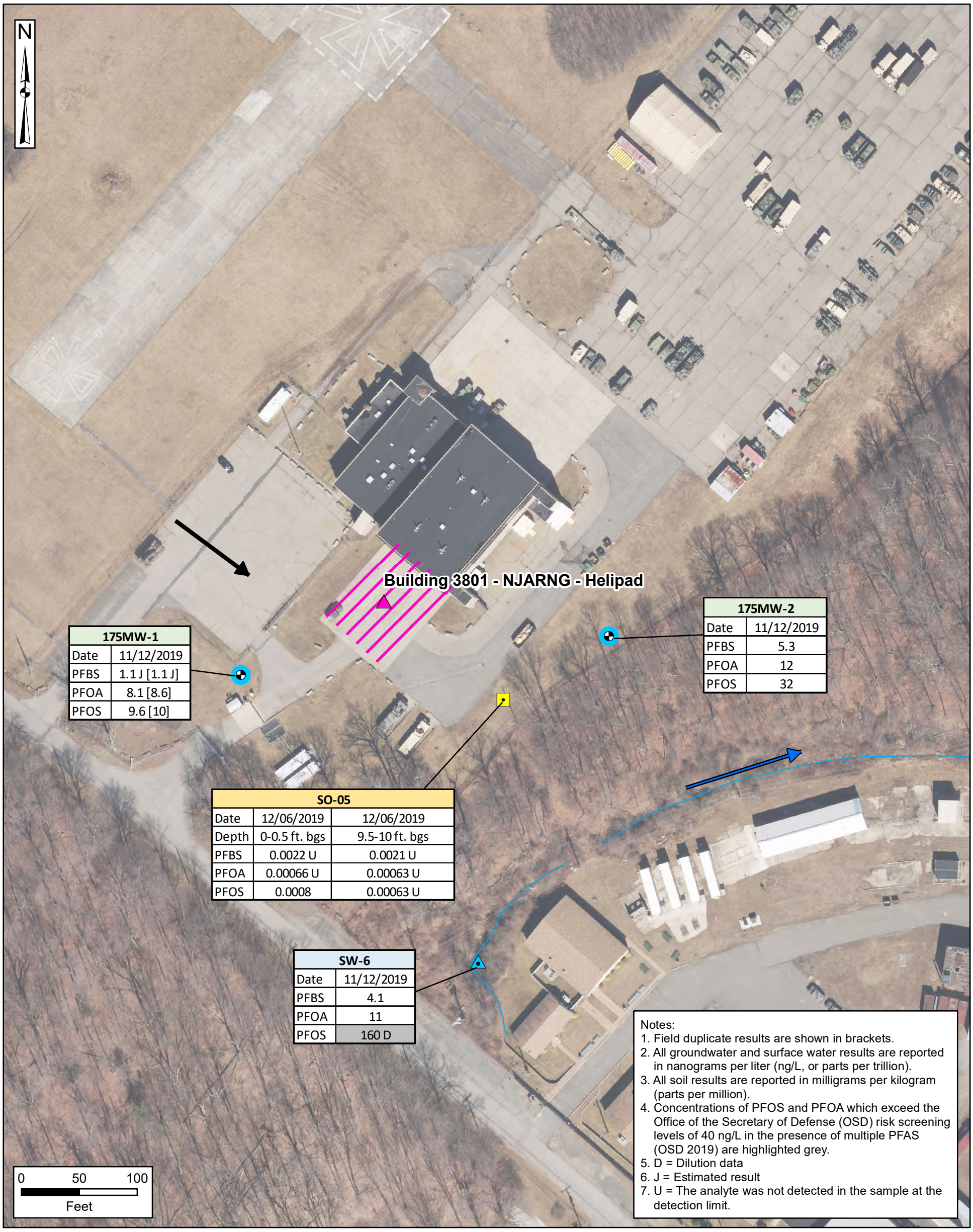
* Proposed location not collected, see Non-Conformance Reports / Deviations Section in SI Report

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 3-11
AOPI Building 3801 - NJARNG - Helipad
Sampling Results



AOPI Location
AFFF Use Area
River/Stream
Surface Water Flow Direction
Assumed Groundwater Flow Direction
Well

Sample Locations

Surface Water
Soil
Groundwater (Existing Well)

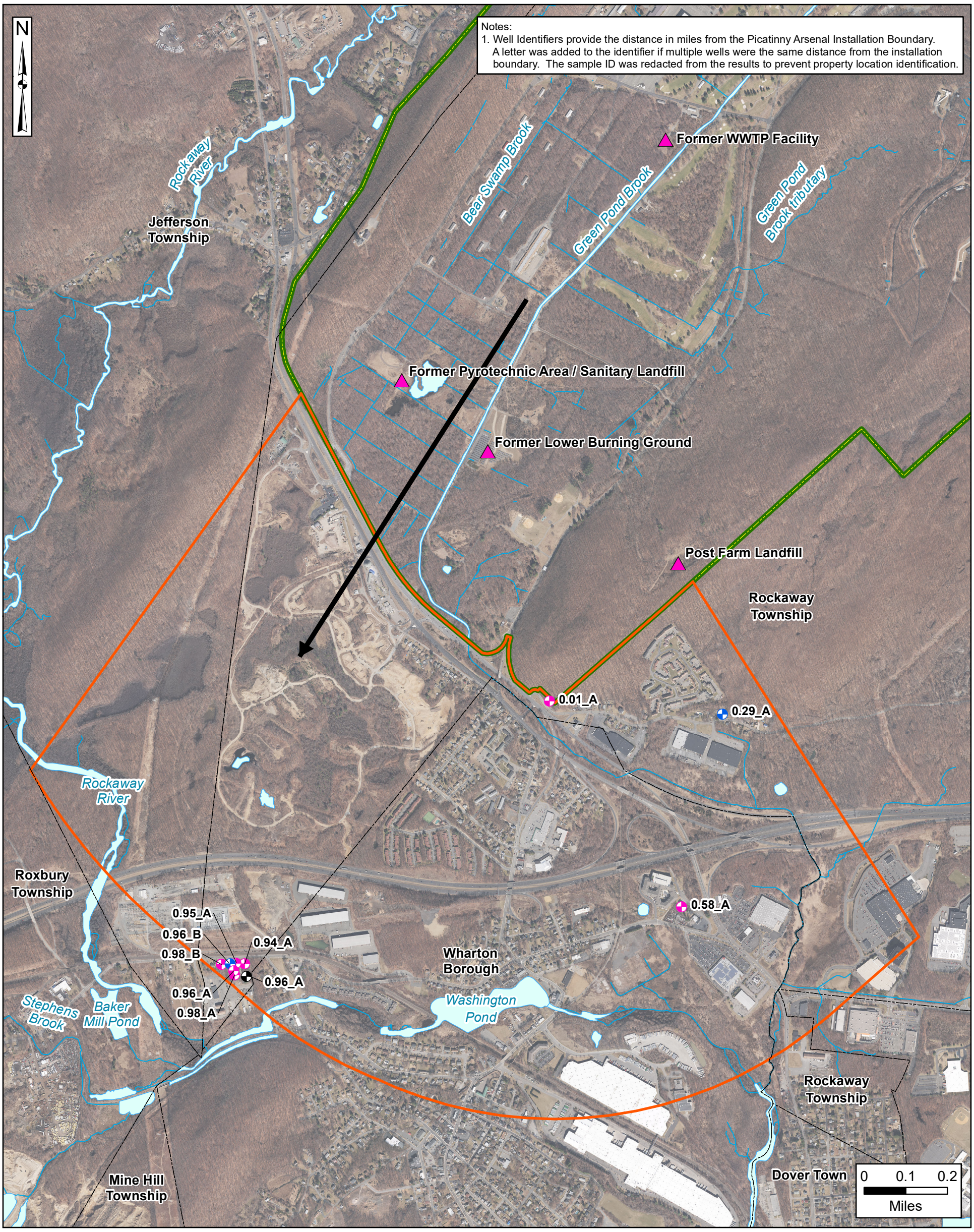
AFFF = aqueous film-forming foam
AOPI = area of potential interest

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 4-2
Potable Off-Post Private Wells



Installation Boundary
AOPI Location
Downgradient Area
Groundwater Flow Direction
Municipal Boundary

Potable Well - Sampled
Potable Well - Identified
Possible Well Identified. Owner has been provided questionnaire

AOPI = area of potential interest

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

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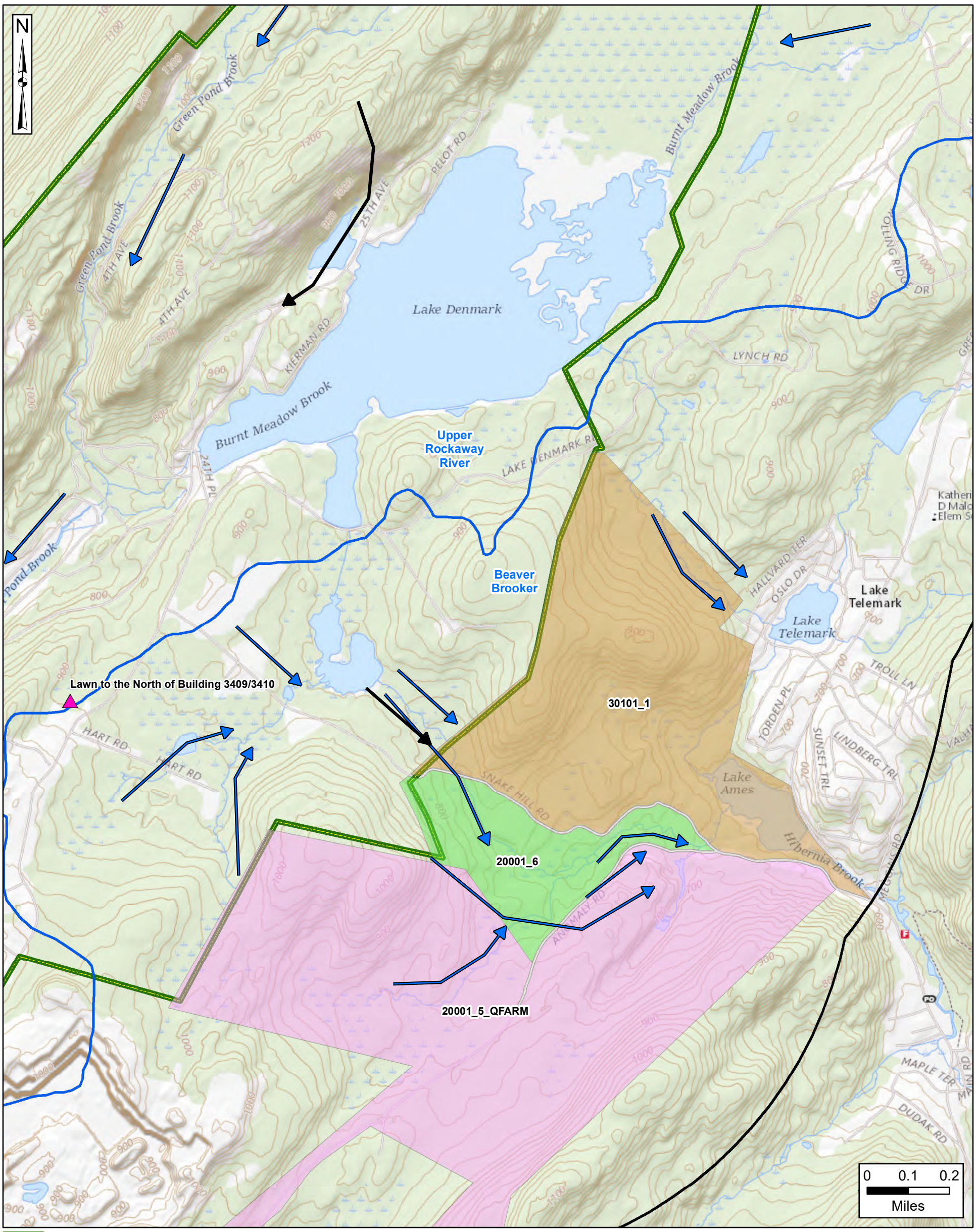
Figure 4-3
Properties Identified Off Eastern Boundary



Installation Boundary
1-Mile Radius
AOPI Location
Watershed Boundary
Surface Water Flow Direction
Groundwater Flow Direction

Block 30101, Lot 1 - This is an approximately 286-acre lot, owned by Rockaway Township and classified as public land. This is currently used as Lake Ames Park and park buildings are reportedly located on the property.

Block 20001, Lot 6 - This is an approximately 80-acre lot, owned by Morris County and classified as vacant land. No buildings were identified on this property.

Block 20001, Lot 5 - This is an approximately 12-acre lot, owned by Rockaway Valley Environmental, which is categorized as qualified farmland. No buildings were identified on this property.

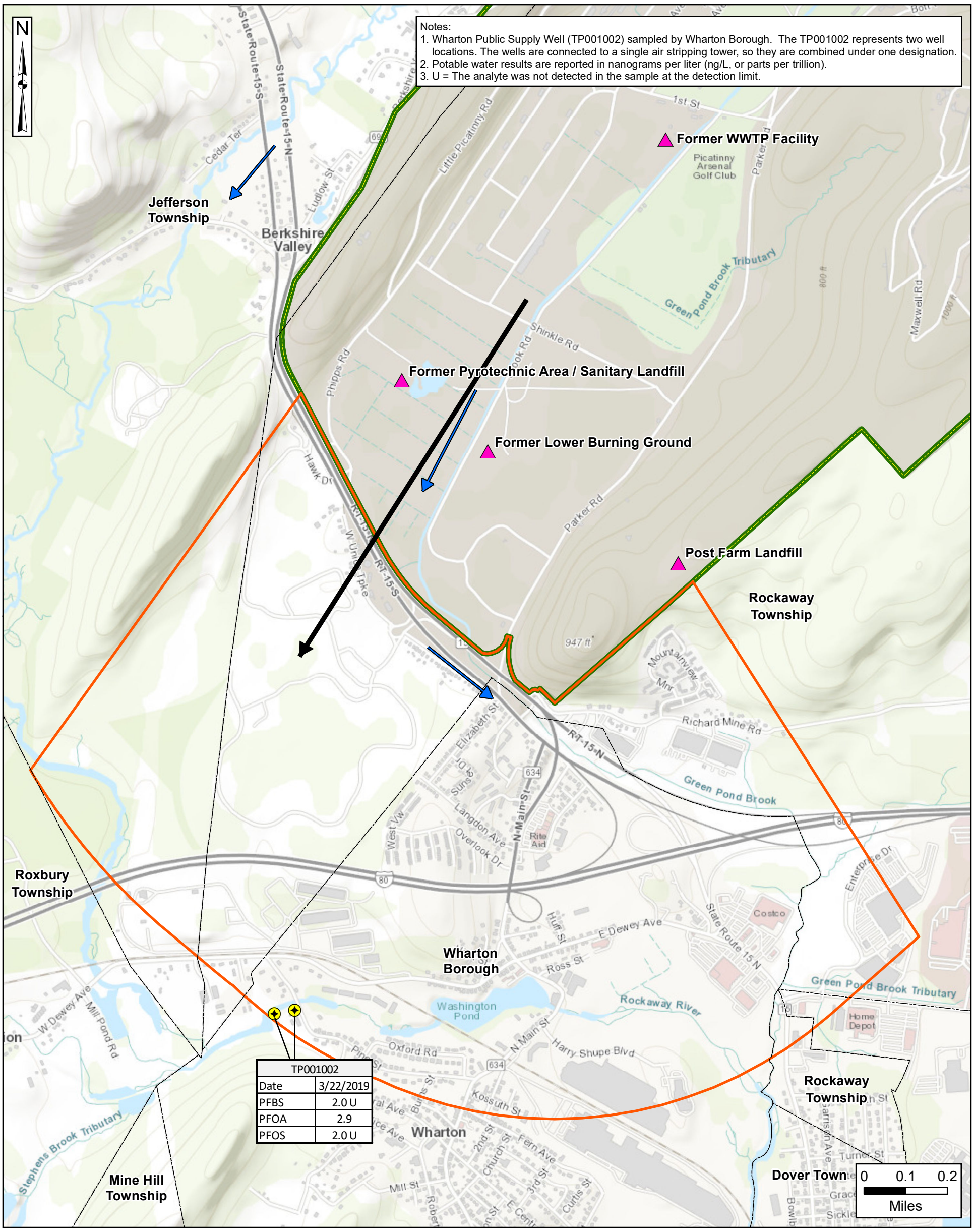
AOPI = area of potential interest

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, USGS Topo

Coordinate System:
WGS 1984, UTM Zone 18 North

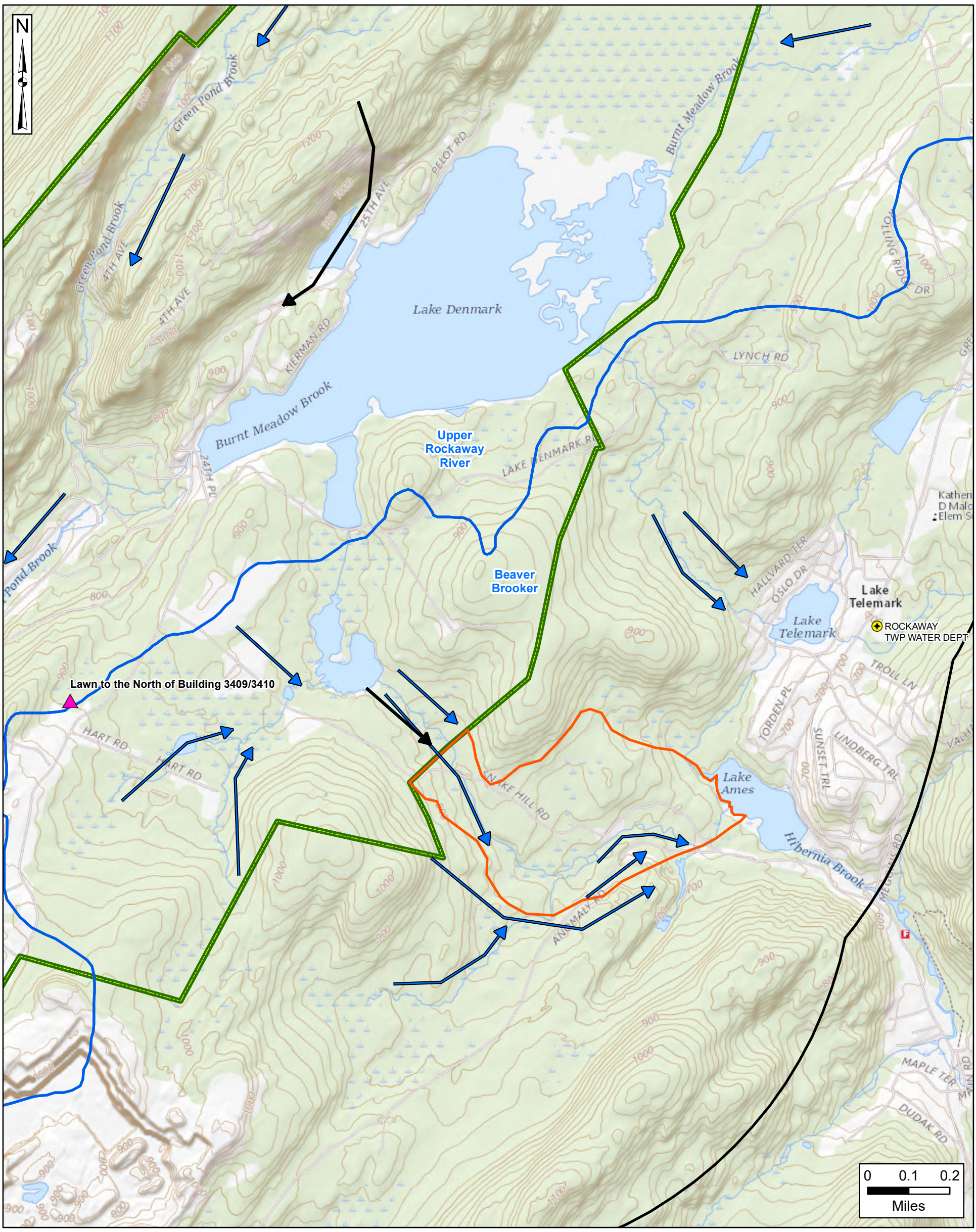
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 4-4
Public Potable Wells Identified Downgradient of Southern Boundary



USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 4-5
Public Potable Wells Identified Downgradient of Eastern Boundary



Installation Boundary
1-Mile Radius
AOPI Location
Watershed Boundary
Surface Water Flow Direction
Groundwater Flow Direction
Water Supply Well
Expected Downgradient Area

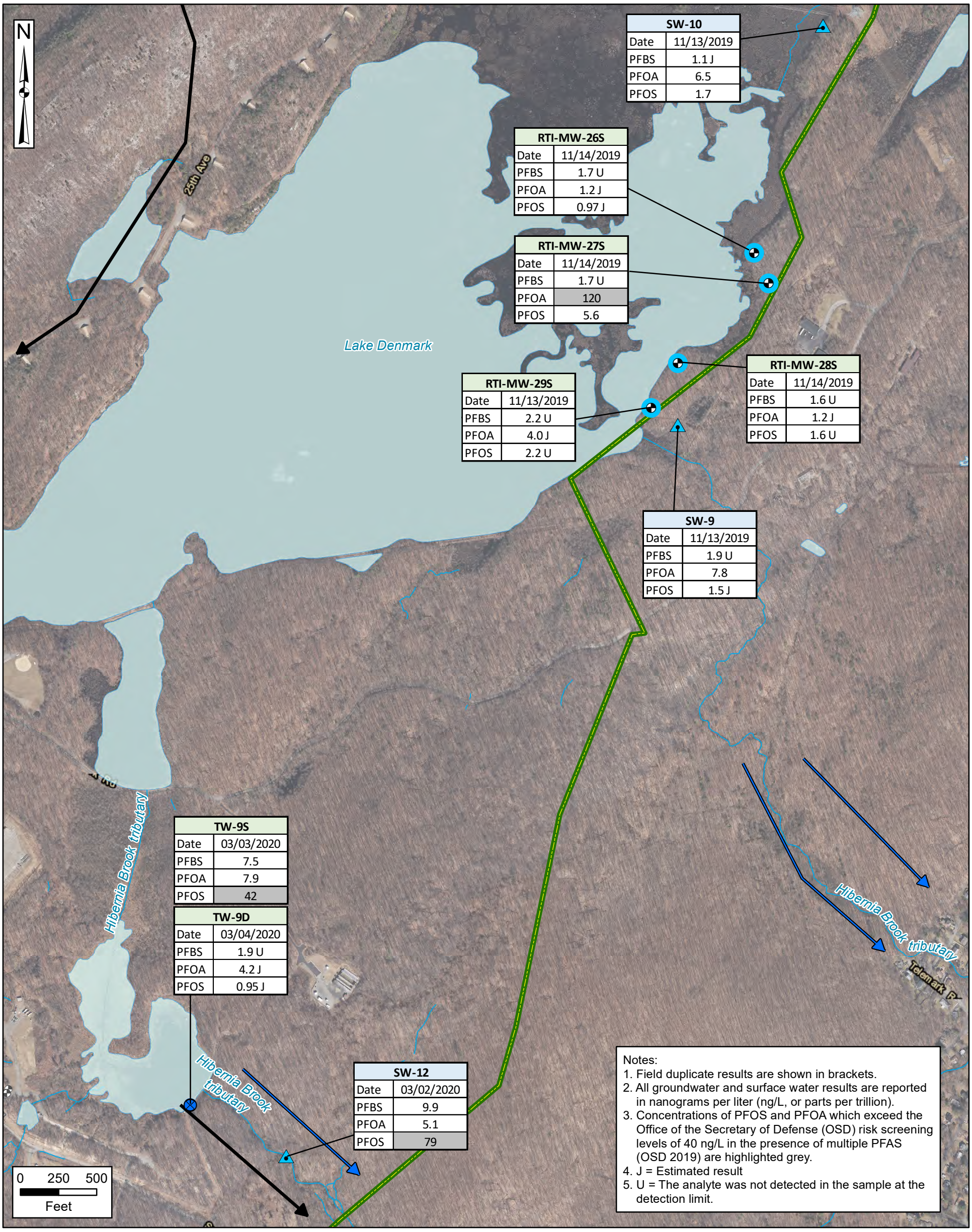
AOPI = area of potential interest

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, USGS Topo

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 5-1
Eastern Boundary - On-Site Sampling Results



Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

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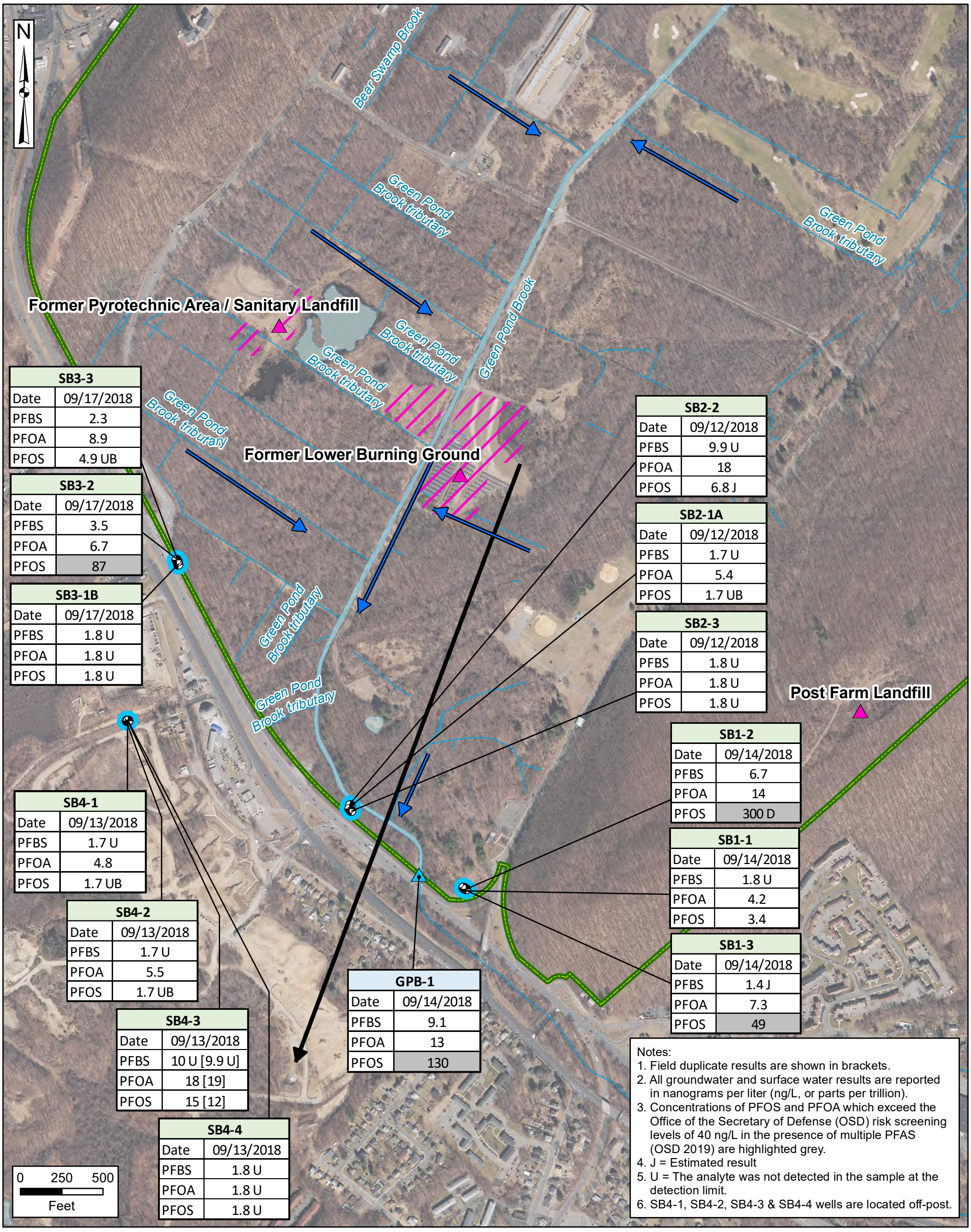
Figure 5-2
Southern Area Boundary
Sampling Results



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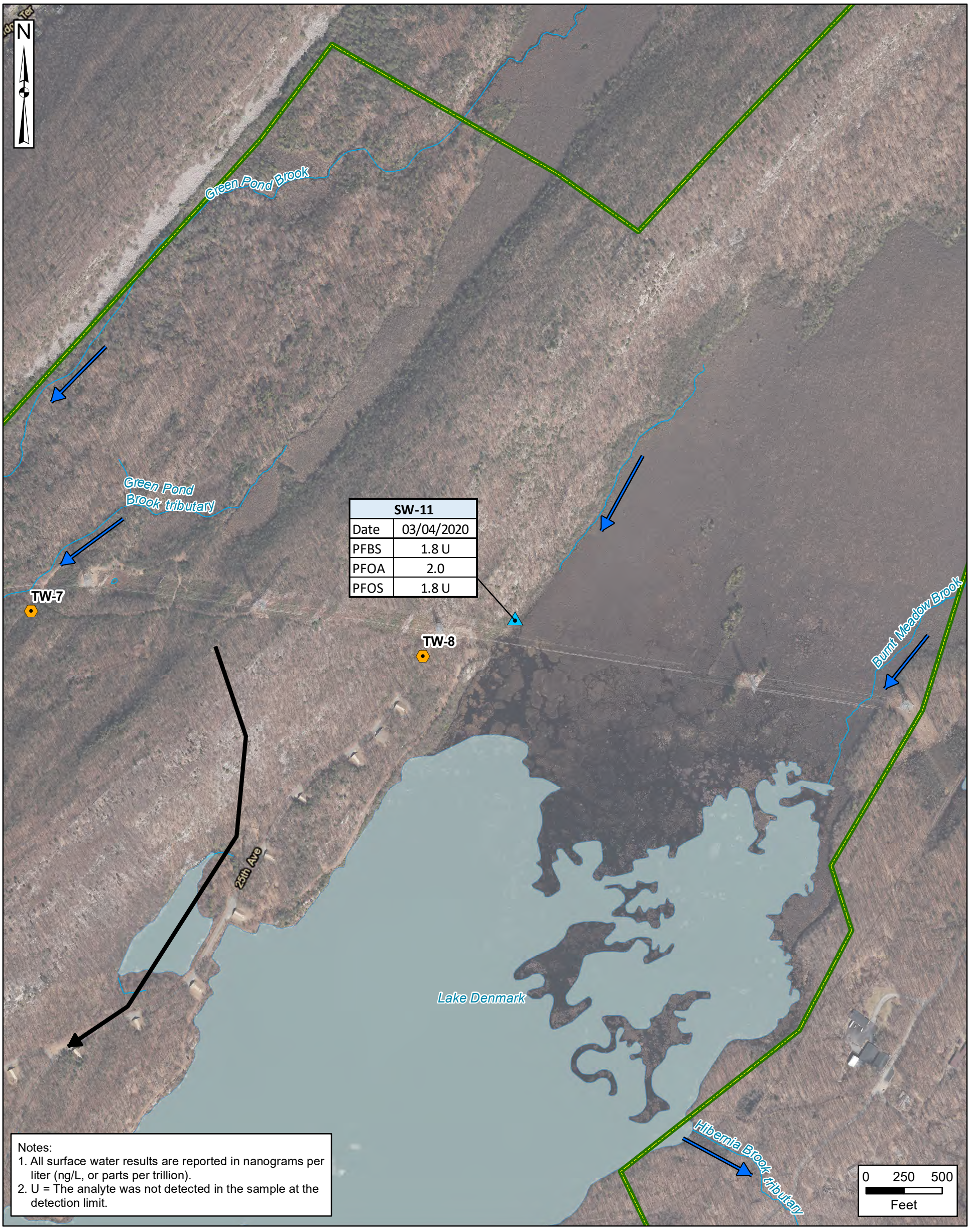
Picatinny Arsenal, NJ

Figure 5-3
Northern Boundary - On-Site Sampling Results



Notes:
1. All surface water results are reported in nanograms per liter (ng/L, or parts per trillion).
2. U = The analyte was not detected in the sample at the detection limit.

Installation Boundary
River/Stream
Water Body
Surface Water Flow Direction
Groundwater Flow Direction

Sample Locations
Surface Water

Proposed Sample Location*
Groundwater (Temporary Well)

* Proposed location not collected, see Non-Conformance Reports / Deviations Section in SI Report

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 5-4
Mid-Valley Upgradient On-Site Sampling Results

Installation Boundary
River/Stream
Water Body
Groundwater Flow Direction
Well

Sample Locations

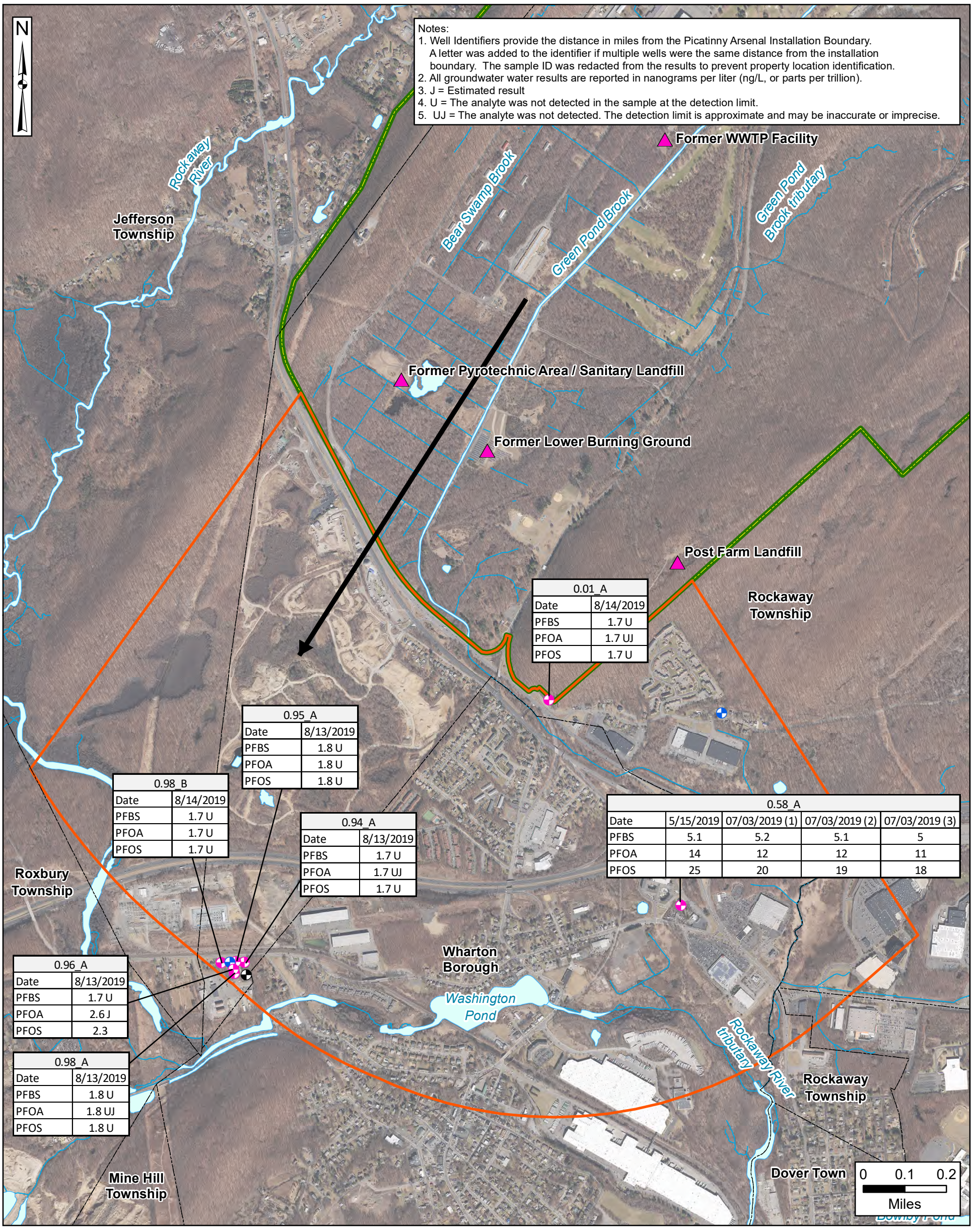
Groundwater (Existing Well)

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

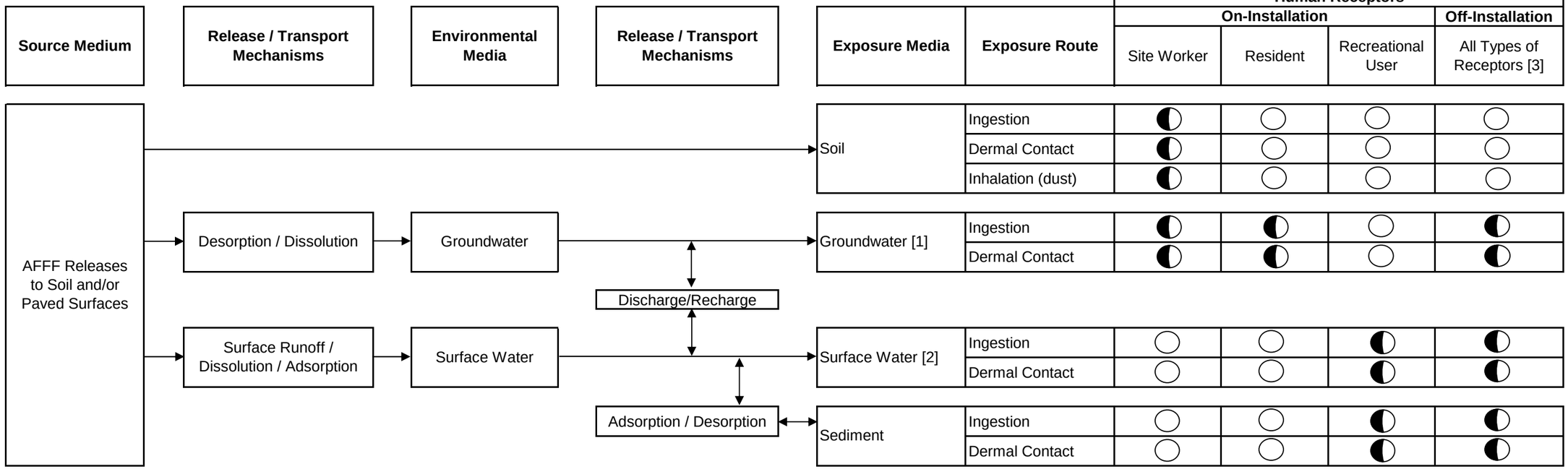
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 5-5
Potable Off-Post Private Wells
Sampling Results



Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North



Legend:

◐ = Potentially Complete Exposure Pathway

◯ = Incomplete Exposure Pathway

Notes:

[1] Groundwater exposure pathway describes a drinking water scenario only.

[2] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes an outdoor recreational scenario.

[3] All types of off-installation human receptors include drinking water receptors and recreational users.

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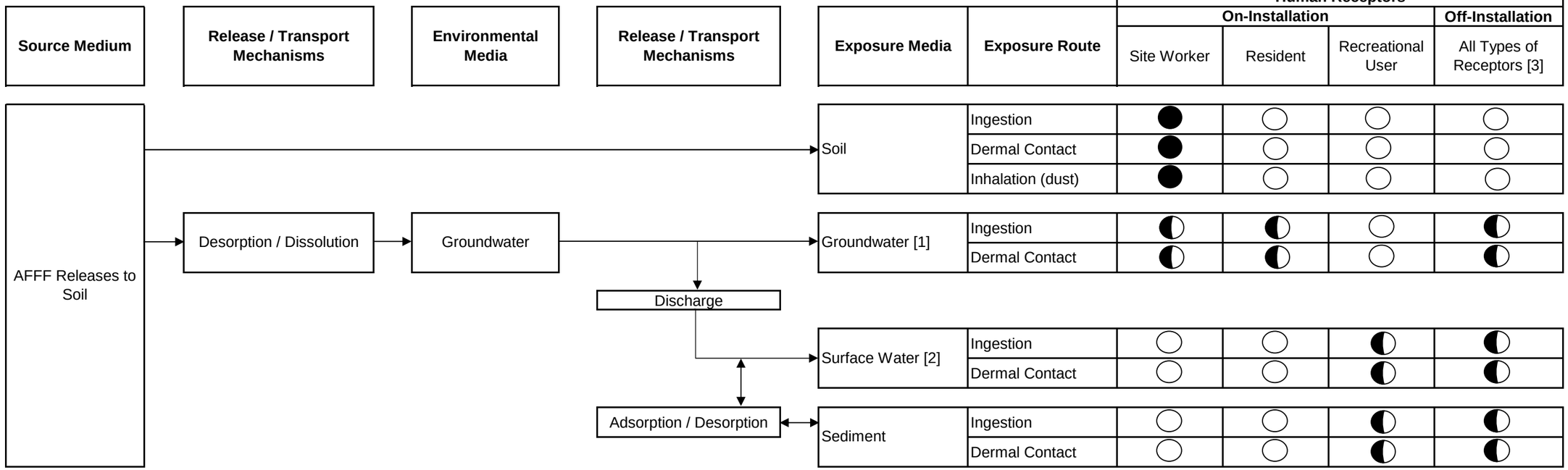
Conceptual Site Model - AOPI Building 169 - Firehouse 1
USAEC PFAS Preliminary Assessment / Site Inspection
Picatinny Arsenal, NJ

Figure 5-6



Legend:

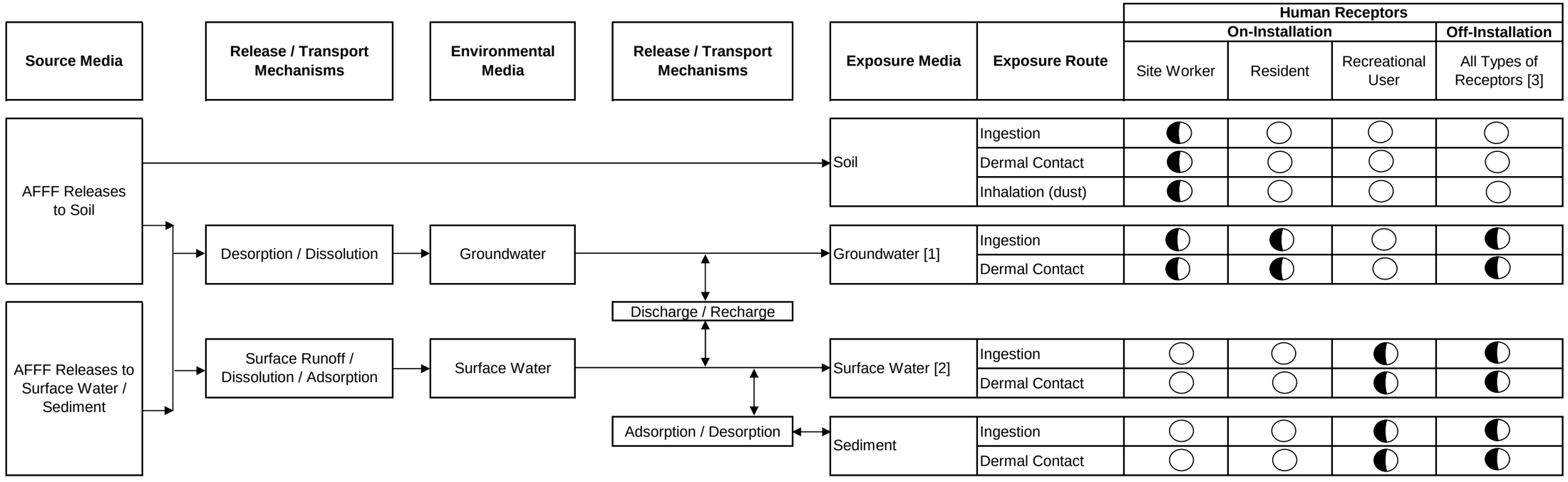
- = Complete Exposure Pathway
- = Potentially Complete Exposure Pathway
- = Incomplete Exposure Pathway

Notes:
[1] Groundwater exposure pathway describes a drinking water scenario only.
[2] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes an outdoor recreational scenario.
[3] All types of off-installation human receptors include drinking water receptors and recreational users.

ARCADIS

Conceptual Site Model - AOPI Building 3316 - Firehouse 2
USAEC PFAS Preliminary Assessment / Site Inspection
Picatinny Arsenal, NJ

Figure 5-7



Legend:

◐ = Potentially Complete Exposure Pathway

◯ = Incomplete Exposure Pathway

Notes:
[1] Groundwater exposure pathway describes a drinking water scenario only.
[2] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes an outdoor recreational scenario.
[3] All types of off-installation human receptors include drinking water receptors and recreational users.

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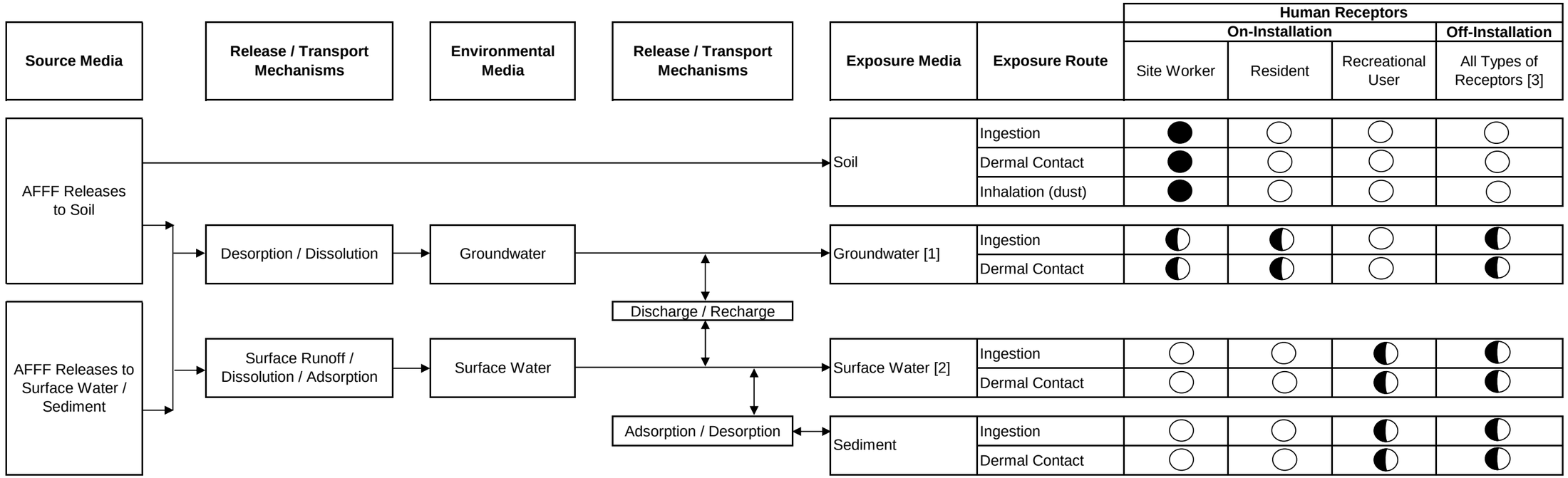
Conceptual Site Model - AOPIs Former Pyrotechnic Area and Sanitary Landfill and Former Lower Burning Grounds
USAEC PFAS Preliminary Assessment / Site Inspection
Picatinny Arsenal, NJ

Figure 5-8



Legend:

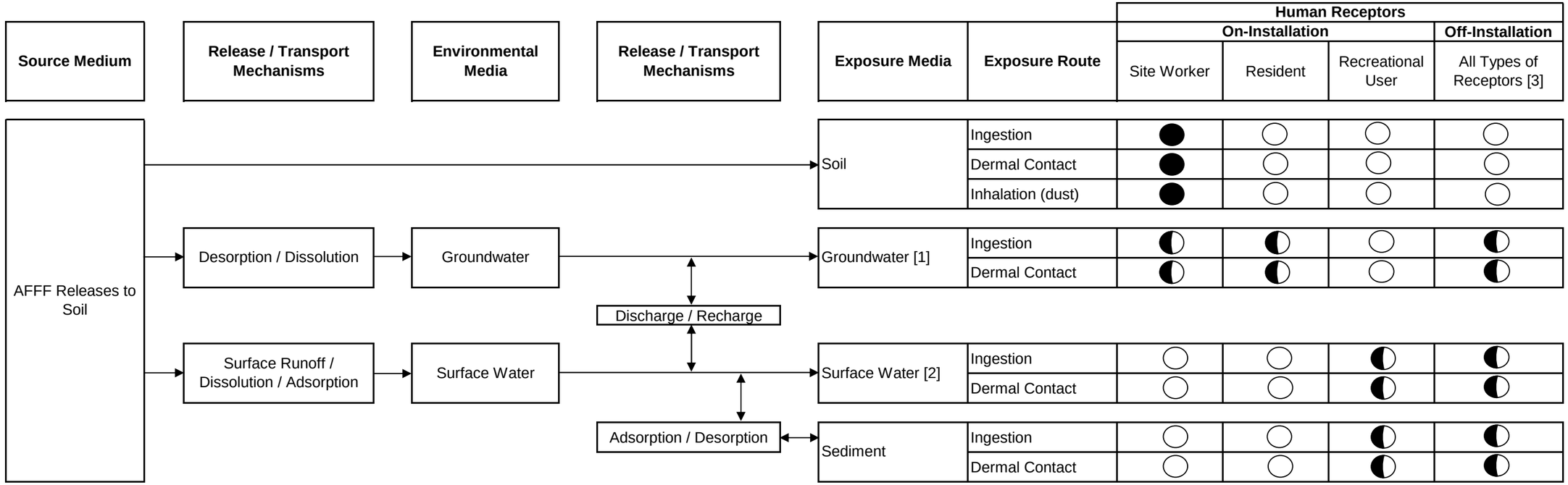
- = Complete Exposure Pathway
- = Potentially Complete Exposure Pathway
- = Incomplete Exposure Pathway

Notes:
[1] Groundwater exposure pathway describes a drinking water scenario only.
[2] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes an outdoor recreational scenario.
[3] All types of off-installation human receptors include drinking water receptors and recreational users.

ARCADIS

Conceptual Site Model - AOPI Area 1222 - Gorge
USAEC PFAS Preliminary Assessment / Site Inspection
Picatinny Arsenal, NJ

Figure 5-9



Legend:

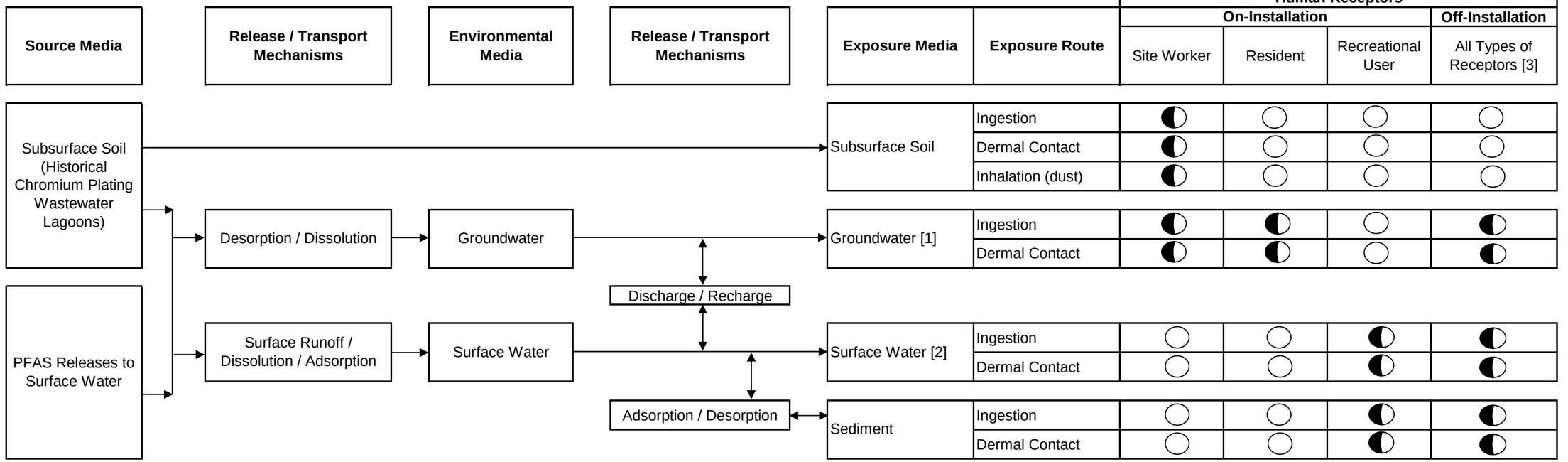
- = Complete Exposure Pathway
- = Potentially Complete Exposure Pathway
- = Incomplete Exposure Pathway

Notes:
[1] Groundwater exposure pathway describes a drinking water scenario only.
[2] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes an outdoor recreational scenario.
[3] All types of off-installation human receptors include drinking water receptors and recreational users.

ARCADIS

Conceptual Site Model - AOPI Lawn to the North of Building 3409/3410
USAEC PFAS Preliminary Assessment / Site Inspection
Picatinny Arsenal, NJ

Figure 5-10



Legend:

◐ = Potentially Complete Exposure Pathway

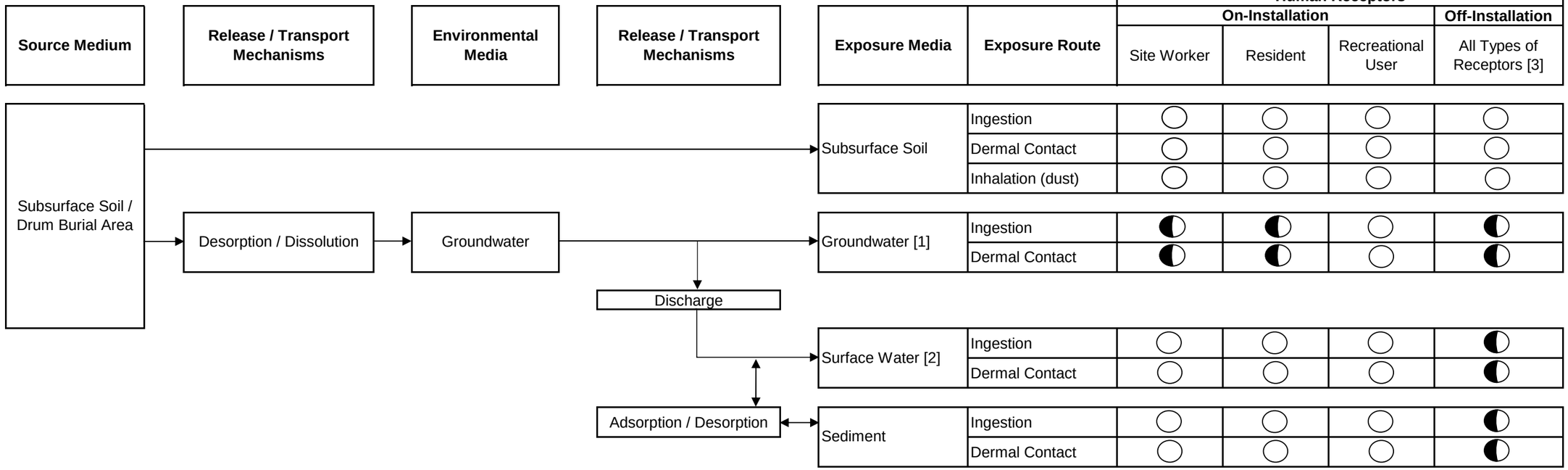
◯ = Incomplete Exposure Pathway

Notes:
[1] Groundwater exposure pathway describes a drinking water scenario only.
[2] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes an outdoor recreational scenario.
[3] All types of off-installation human receptors include drinking water receptors and recreational users.

ARCADIS

Conceptual Site Model - AOPI Former Building 24
USAEC PFAS Preliminary Assessment / Site Inspection
Picatinny Arsenal, NJ

Figure 5-11



Legend:

◐ = Potentially Complete Exposure Pathway

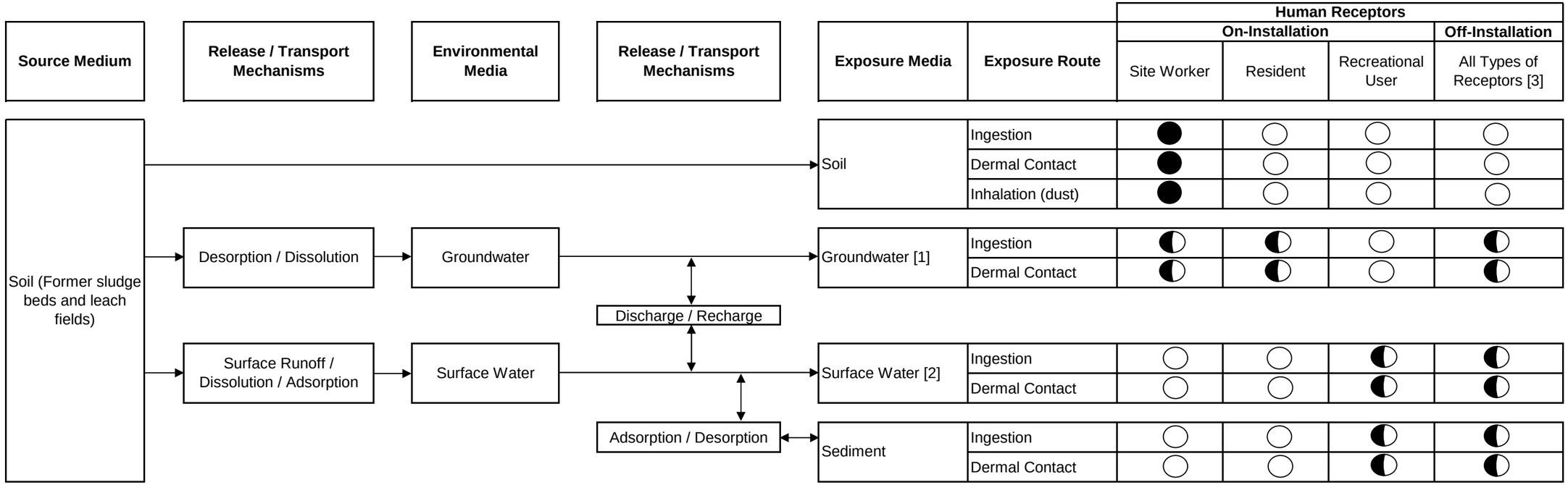
◯ = Incomplete Exposure Pathway

Notes:
[1] Groundwater exposure pathway describes a drinking water scenario only.
[2] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes an outdoor recreational scenario.
[3] All types of off-installation human receptors include drinking water receptors and recreational users.

ARCADIS

Conceptual Site Model - AOPI Post Farm Landfill
USAEC PFAS Preliminary Assessment / Site Inspection
Picatinny Arsenal, NJ

Figure 5-12



Legend:

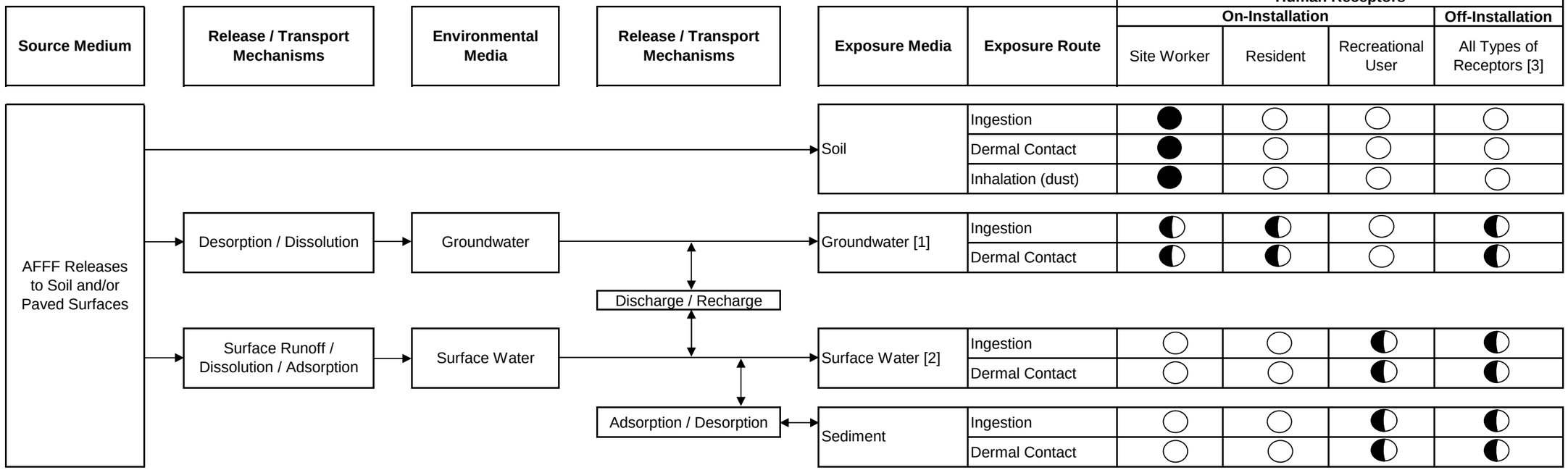
- = Complete Exposure Pathway
- = Potentially Complete Exposure Pathway
- = Incomplete Exposure Pathway

Notes:
[1] Groundwater exposure pathway describes a drinking water scenario only.
[2] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes an outdoor recreational scenario.
[3] All types of off-installation human receptors include drinking water receptors and recreational users.

ARCADIS

Conceptual Site Model - AOPI Former WWTP Facility
USAEC PFAS Preliminary Assessment / Site Inspection
Picatinny Arsenal, NJ

Figure 5-13



Legend:

- = Complete Exposure Pathway
- = Potentially Complete Exposure Pathway
- = Incomplete Exposure Pathway

Notes:
[1] Groundwater exposure pathway describes a drinking water scenario only.
[2] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes an outdoor recreational scenario.
[3] All types of off-installation human receptors include drinking water receptors and recreational users.

ARCADIS

Conceptual Site Model - AOPI Building 3801 - NJARNG Helipad Area
USAEC PFAS Preliminary Assessment / Site Inspection
Picatinny Arsenal, NJ

Figure 5-14